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CONTENTS.

EDITORIAL: Page.
Paragraphs ... 155
ILLUSTRATED ARTICLES:
A New Type of Engine ... 157
The Elements of Practical Electricity, by Dr. Louis Bell ... 158
History of Electricity, by P. F. Mottelay ... 159
The Rollason Gas Engine ... 161
The Duggan Bracket and Railway Chair ... 163
A Railroad Car Lighted by Primary Batteries ... 163
An Electro-Therapeutical Outfit ... 164
The Ball Engine Company's Cross Compound Engine ... 164
A Portable Mining Pump ... 165
The New Short Railway Generator ... 165
Electric Motors for Driving Light Machinery ... 166
The Adams Rotary Engine ... 166
A Solenoid Coal Cutter ... 166
Cope's Wire Grip for Linemen ... 166
MISCELLANEOUS:
Latest Foreign Electrical News ... 156
Success of the Lauffen-Frankfort Power Plant ... 156
An Electrical Library Free ... 156
A Practical Problem in Distribution, by Prof. E. P. Roberts ... 156
The Story of a Curious Electrical Fault ... 157
The Construction and Maintenance of Underground Circuits, by S. B. Fowler ... 160
The Montreal Exhibition ... 161
The Cost of Electric Traction ... 162
Transportation to the Montreal Convention ... 163
Street Railway Convention at Pittsburgh ... 163
Electricity at the World's Fair ... 163
Carbon Resistances ... 166
FINANCIAL INTELLIGENCE: The Electrical Stock Market, 167; New Incorporations, 167; Affairs of the Companies, 167.
SPECIAL CORRESPONDENCE: New York Notes, 167; New England Notes, 167; Western Notes, 167; Southern Notes, 168; Canadian Notes, 168; English Notes, 168.
ANSWERS TO CORRESPONDENTS ... 168
NEWS OF THE WEEK: The Telegraph, 168; The Telephone, 168; The Electric Light, 168; The Electric Railway, 168; General Applications of Power, 169; Personals, 169; Legal Notes, 169; Educational Notes, 169; Miscellaneous Notes, 169.
INDUSTRIAL AND TRADE NOTES ... 169
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 170

Elementary Electricity. ON another page we begin the publication of a series of papers on the elements of practical electricity. They are not intended to constitute in any sense a comprehensive treatise on the modern science of electricity, nor to enter at all into the mathematical discussion of electrical quantities; their purpose is simply to give the beginner a practical every-day view of facts, and experiments from which facts may be deduced, from the standpoint of one who wishes them stated in language "understanded of the people" instead of in equations. It will be, of course, impossible entirely to avoid mathematics, but nothing beyond a good working knowledge of arithmetic is presupposed, and anything more advanced will be explained as it occurs. So far as possible it is intended to avoid time-worn theories and modes of explanation, and to present the substance of elementary electricity in a form appropriate to the day in which we live. Experiments and apparatus are described in detail for those who desire to follow this course completely as most students will find advantageous. There will be much, of course, that will seem extremely rudimentary to some of our readers, but it will not be so with all, and those who feel that the work is too simple for them are fortunately not compelled to read it.

Laying Underground Cables. IN the present issue we publish a useful little paper on underground electric work. In many large cities a considerable portion of the total electrical distribution that is to be done is underground, and as times goes on the overhead wires will be much less used than at the present time. Mr. Fowler's article gives a clear, popular idea of the way in which the laying of underground conductors is carried out, and the precautions that are necessary in the maintenance of the system after it is completed. Such information will be useful and suggestive to many of our readers, even to those who have already some experience in this particular class of work. The precautions to be employed in laying and testing cables are described with considerable detail, and one point that is especially striking is the strong recommendation as to the telephone as a testing instrument. Although its use in this way is not unfamiliar to those engaged in practical work, the ordinary electrician would not be likely to think of it, and with this suggestion a little judgment would probably enable him to adapt the telephone to the particular tasks in hand with very excellent results. There are many other good practical points mentioned, and altogether the paper is one that will commend itself to the electrician as well as to the general reader.

The Street Railway Convention. IN another column will be found the programme of the coming Street Railway Convention in Pittsburgh. It was openly predicted during the meeting at Buffalo last year that the horse had made his appearance for the last time in the deliberations of the American Street Railway Association. The list of papers to be read at the coming gathering not only is strong evidence in this direction, but is a very striking comment on the spirit of the times as regards methods of propulsion; in fact, the subjects discussed would be quite as much at home in a convention of electrical engineers as with street railway men. There are still left, we believe, surviving growlers who like to talk about the "Electric Street Railway Bubble," the "Fad for Electric Traction," and generally of the hopeless view of the situation, and turn lovingly to the "good old times" when the street cars rumbled along drawn by a pair of spavined horses or a dilapidated and surly mule. If these gentry will take the trouble to attend the coming convention of the progressive street railway men of America, they will be converted or retire to some out of the way barbaric region to carry out in peace and quiet their antiquated ideas, quite undisturbed by the "deadly trolley." A list of something like 300 electric roads—how many at the present moment it is impossible to say, for the number is growing so rapidly—is practical demonstration enough of the merits of the system. Street railway companies are by no means in business for their health, and if traction by horses really paid better than that by electricity, to find an electric road would require a professional detective.

Cost of Electric Traction. APROPOS of our remarks concerning the apparent decided success of the storage battery in Birmingham, it may be instructive to review in brief the report of the West End Street Railway in Boston for the month of July, which is published in considerable detail on another page. The lesson of that month is but a repetition of former experience. To make the comparison with foreign experiments easier, the items of motive power and car repairs in the West End report should be added together. The net result is that the haulage for electric cars cost 8.17 cents a car mile, while for the horse cars it cost 10.99 cents, the former running 377,000 miles during the month, and the latter 1,120,000, figures large enough to insure a fair average. The absolute cost of traction here and abroad cannot fairly be compared, as the difference is so great as to make it almost self-evident that items charged to traction in the one case are put in another account in the other. We are certainly, therefore, not justified in concluding that the cost of overhead traction is about 8 cents per car mile compared with nearly 15 cents for the storage battery under normal conditions. Curiously enough in each case the total repairs for the electric cars are very nearly double those for the horse cars, although the car repairs in Boston amount to less than one-third as much per car mile as those in Birmingham, suggesting at least that the batteries in the latter system underwent serious depreciation. It is to be hoped that before long definite reports from one of the American storage battery roads may be received, so as to permit of a fairer comparison of the two systems, although from the great size of the West End plant any such comparison would be necessarily faulty.

Storage Battery Traction Abroad. THE advocates of electrical traction by means of storage batteries may find some crumbs of comfort in the experience of the Birmingham Central Tramways Company in England. The electric cars in that city have carried nearly 1,200,000 passengers in the past year. The gross receipts amounted to about $43,600, and the expenditures to $28,500, leaving a handsome profit. The same company operates a portion of its lines by horses and another portion by cables. The comparison between the expense of horse and electric traction is both interesting and decidedly satisfactory. Separating the total hauling expenses from the fixed charges, it was found that the former for the electric cars amounted to almost exactly 14¼ cents per car mile, while the traction by horses cost per mile precisely 1 cent more, and this notwithstanding the cost of fuel for the electric cars per car mile was no less than $8\frac{5}{10}$ cents. This latter figure is inordinately high, and speaks ill of the efficiency of station or batteries, or both; but the general result speaks remarkably well for the storage battery, even although the car repairs (including those of battery and motor) amounted to nearly $3\frac{8}{10}$ cents per car mile. This amount points to a considerable depreciation in the car equipment, but in spite of all this the most exacting investor could hardly help feeling pleased with the financial results of the year. About two years ago the public was treated to a report of a very different kind coming from Brussels. It was then found that the cost of traction by storage batteries was so very much greater than by horses that the former service had to be abandoned. The experience at Birmingham will go far to offset the unfortunate results in Belgium, and should give the public greater confidence than it has heretofore been justified in according to storage battery traction. The present report is all the more valuable inasmuch as it comes from the directors of the company, who may be presumed to view the various portions of their investment from a business standpoint, and hence be reasonably unbiased in their estimates. The experience of the last few years has certainly produced salutary results in storage battery work. Experience does teach, even at considerable cost, and it would appear that its lessons have at last been sufficiently valuable to afford substantial encouragement to the advocates of what might be almost an ideal method of propulsion.

Success of the Lauffen-Frankfort Experiment. A CABLE dispatch from THE ELECTRICAL WORLD'S special correspondent brings the important news of the complete success of the great experiment in long distance transmission of power that has been frequently discussed by electricians for the last six months. When it was announced about a year ago that an attempt would be made to deliver two or three hundred horse-power at the Frankfort exhibition from a distance of a little more than 110 miles, and at electromotive forces enormously larger than those now used, the proposition was received by many engineers with a courteous smile of incredulity and a shrug of the shoulders. All sorts of objections were raised; it was predicted, aside from general disbelief in the scheme, that the transformers and machines could not possibly stand the enormous potentials, and leakage on the line would in damp weather consume the entire current, that is if losses due to static charge in the lines left anything for leakage to accomplish; nevertheless the engineers who had proposed the plan quietly went about their business and began experimenting. In February last we noted the successful result of a series of experiments at the Oerlikon works, showing that with oil insulation the enormous voltages could be operated safely and successfully. Still time went on and it was frequently suggested that the proposition was only a bluff anyhow, that nothing would be done even in spite of the experiments that had been tried. Finally when the contracts for the work were let, with a heavy forfeit for non-fulfillment, the public began to realize that something was coming, and we now have the pleasure of announcing the entire success of the preliminary experiments over the full line of nearly 112 miles in length. As is now tolerably well known the line from Lauffen to Frankfort is worked on the rotary current alternating system, the generator for which was described in our issue of Aug. 22. It is adapted to deliver three separate alternating currents of 50 volts and 1,400 ampères, differing in phase by 120 degrees. These currents are not sent directly to the line, but are passed through step-up transformers, sent along the line at the high potential of 13,000 volts, and then utilized in the motor by step-down transformers. These are described in the article just mentioned and, it is only necessary here to say that they are provided with rosin oil insulation. There are four of these transformers, two at each station. The motor is of a construction similar to the dynamo, both being from the designs of Mr. C. E. L. Brown, of the Oerlikon works. The rotary current motor, due primarily to Tesla, has been developed by Von Dobrowolsky in Germany, and the general system employed in the present experiments is due to that engineer. The experiments that have just been made, involving the successful delivery of 200 h. p. at an efficiency of transmission of 75 per cent., are a sufficient demonstration, not only of the judgment and skill with which the engineering details have been carried out, but in a more general way of the enormous possibilities of the alternate current transmission of power over great distances. It is a long step forward in the art of electrical distribution, and marks, perhaps, the beginning of a general revolution. We congratulate most heartily the promotors and executors of this notable enterprise. From the very first we have believed that the work would be carried out with entire success, and have again and again stated that belief in these columns. Delays have intervened, and the issue has to many seemed doubtful, but now the final result not only justifies the predictions we have made but amply fulfills the hope of the farsighted engineers who have accomplished so extraordinary a feat.

Success of the Lauffen-Frankfort Power Transmission Plant.

(By Cable from Carl Hering, Special Correspondent of THE ELECTRICAL WORLD.)

FRANKFORT, Aug. 31, 1891.—The long distance high tension transmission plant between Lauffen-on-the-Neckar and Frankfort has just been successfully tried. Two hundred horse power, utilized in operating a load of incandescent lamps, was transmitted during a rain storm at a voltage of 13,000 volts with entire success. The efficiency was about 75 per cent. A slight accident to the motor itself interrupted the experiments, and further power tests will be somewhat delayed. This experiment settles once for all the feasibility of very long distance transmission of electrical energy by high tension alternating currents, and quiets the skeptics who made gloomy predictions of failure either on the ground of electrostatic losses or of the impracticability of such high potentials.

There are very few Americans now at the Exposition, but the successful inauguration of this important work will probably draw visitors from all parts of Europe.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

LONDON, Aug. 31, 1891.—The Cardiff meeting of the British Association for the Advancement of Science opened on Wednesday, August 19, and the attendance proved to be rather meagre, including but a few scientific men of note. The weather, which has been extremely bad, is perhaps partially to blame for the small number present. Practical papers, in the electrical line at least, were conspicuously absent, and the theoretical ones were of comparatively little interest. Mr. James Swinburne's paper on the causes of the variations in the electromotive force of Clark standard cells gave some favorable results of extended investigation. Prof. Ayrton gave some further particulars regarding the magnetic disturbances caused by the City & South London Railway, and a Mr. Bennett, of one of the telephone companies, described an ingenious modification of the existing plans whereby electrostatic induction is used to ring up the exchange.

An electric welding company to operate the Thomson electric welding system has been organized and the subscription books have been closed; its capital stock is $2,300,000, at a par value of $50 per share; it comprises 45,000 ordinary shares and 10,000 founders' shares. Of this the European Electric Welding Company received 8,333 ordinary and 400 founders' shares, besides half a million dollars cash. One million dollars in capital stock and about a quarter of a million in money are to be put in the treasury for working capital. The recent death of Postmaster-General Raikes is now ascribed to overwork, instead of the direct result of an electric shock received in a thunder storm.

An Electrical Library Free.

In order to compensate those of our readers who interest themselves in increasing the circulation of THE ELECTRICAL WORLD, we will send electrical books to the value of

$50.00 FOR THE LARGEST LIST

of new subscriptions (not renewals) reaching us before November 30, 1891. We will also send books to the amount of

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The subscriptions must be taken at the full price of $3 a year, and a rebate or part of the premium must not be offered or given the new subscriber as an inducement to subscribe. On receipt of the names of those from whom it is intended to solicit subscriptions, we will mail a free sample copy of the paper to each one on the list. We will also send, free on application, printed matter relating to THE ELECTRICAL WORLD to assist those engaged in obtaining subscriptions.

As there is a time limit to this offer, it is hoped that all who wish to avail themselves of it will get to work at once. For extra copies of the paper, circulars or further particulars address

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A Practical Problem in Distribution.*

BY PROF. E. P. ROBERTS.

A study of the following case, with the conditions specified, will give some insight into many of the points which should be considered in calculating the most economical loss. Often such matters are slightingly called "theory," but results show that the practice of theory, based on facts, brings returns in cash.

Example.—Conditions: Cost of poles complete with cross arms, erected, is considered as a constant—that is, the same sized pole would be used whether the wire were No. 8 or No. 4, and the same number would be used. Usually this assumption would, for circuits in city streets, agree with facts.

Wire.—Cost per pound constant—that is, for such sizes as are used for arc circuits it is here considered—although not quite true—that the price per pound is constant.

CASE I.

	Cost per mile.	Per cent. of total.
50 poles at $4	$200	53.0
Insulated No. 6 wire, 110 pounds per thousand feet at 25 cents	145	38.5
Add 5 per cent. for slack, etc	7	1.9
Labor running wire	25	6.6
Total	$377	

No. 6 wire has 80 pounds of copper wire per thousand feet, or 442 pounds per mile. Add 5 per cent. and obtain 443 pounds of copper wire, $377 (in place), $1,702 per ton.

CASE II.

	Per mile.	Per cent. of total.
Poles as before	$200	43.7
Insulated No. 4 wire, 165 pounds per thousand feet at 25 cents	217	47.4
Five per cent	11	2.4
Labor running wire	30	6.5
Total	$458	

No. 4 wire has 125 pounds copper per thousand feet, or 660 pounds per mile. Add 5 per cent. and obtain 690 pounds of copper for $458, or $1,327 per ton.

Comparing cases No. 1 and No. 2 it becomes evident that within the limits considered the larger the wire the less the cost per ton in place. When the size reaches No. 0 or No. 00 it not only needs more poles but is more difficult to place than smaller wire, and also needs repairing, pulling up, etc., oftener, and, therefore, the labor item of installing may be much larger than in the above example. If the case be one of running wires in city streets, particularly if the cost of "cutting in" be considered, the labor may amount to $50 or $75, or even more, per mile. The amount to be allowed for depreciation of poles (if of wood renewals in from 5 to 10 years); deterioriation of insulating material of wire; taking slack out of lines, or other line repairs not caused by dispensation of providence or by common councils (such repairs not being calculable). The pole depreciation per mile is independent of the size of the wire, provided that the size of the wire is between such limits as to make the same pole spacing advisable. The amount to be allowed for depreciation is not only the life divided by the cost but to such amount should be added the cost to take out the old pole and place the wire on the new, less the value of the old pole, and often the labor of changing will exceed the cost of the pole. The necessity for repairs, pulling up, etc., increases with the size of the wire and length of space. The determination of the amount to allow for depreciation of insulating covering depends upon the character of the same and the climate, but, generally, should be in an inverse ratio to the first cost, because a cheap covering may not last two years and a good covering will cost more and last much longer.

The pole item, as above considered, is a large percentage of the total cost, but if a number of lines can utilize the same poles such percentage will be rapidly reduced below the labor item.

If the wire be placed under ground the copper may not cost 20 per cent. of the total amount of the installation, and, therefore, can be doubled for 20 per cent., or 25 per cent. increase of first cost.

The above states only some of the variables entering the problem. If the cost per ton of copper and the amount to be allowed for depreciation and repairs per ton can be determined, the next step is to decide upon the cost of one electrical horse power delivered to the lines. To determine the cost to develop one horse-power hour the total cost of operation is divided by the total number of horse-power hours, but, as before shown, a figure arrived at upon such a basis is not of any use in determining the cost of the energy lost in the line. For example, take a case where the desired unit for arc dynamos is to be 65 light machines and a 100 h. p. engine is to drive two of the same. Consider 10 ampères to be the current, and the combined length outside of all buildings of the two circuits be eight miles, and the engine and both dynamos run 10 P. M. circuits, an average of four hours per day for 300 days—1,200 hours per annum.

First, consider whether to put up No. 4, No. 6 or No. 10 wire. The smallest wire advisable to even consider for such a circuit being No. 10 B. & S. G., and No. 4 is as large as ordinarily required for economy, unless power is very expensive. The line loss, if No. 6 be used, is the R of 5,280 + 5 per cent. (to cover cutting in, etc.), or 5,544 × 8 (miles) = 44,352 feet, which at .4 of an ohm per thousand feet is 17.4 ohms; therefore requiring 174 volts for 10 ampères; which, if 50 volts per lamp be required, equals three lamps and 24 volts. Therefore 1,740 watts, 2.33 h. p.. will be lost in the line, and require, if the dynamo have an efficiency of 90 per cent., 2.58 h. p. to be developed by the engine.

If No. 10 be used, R of 44,352 feet at one ohm per thousand feet, 44 ohms taking 444 volts, or the equivalent of almost nine lamps, and absorbing 4,440 watts, 6 h. p., thereby requiring 6 h. p. from the engine.

Therefore by using No. 10 wire instead of No. 6 we have cut down the possible revenue from the dynamos five lamps. Further consideration may progress along one of two lines. 1st. If the dynamo's capacity is considered sufficient for all probable needs, after cutting from a total of 126 (130 - 4) lights to 121 lights, which is better to use, No. 6 or No. 10? 2d. If the five lights are likely to be desired, will No. 10 be more economical than No. 6?

1. The difference in first cost between No. 6 and No. 10 equals the difference in cost of wire plus some amount of labor of placing wire:

44,352 feet No. 6 at 110 pounds per thousand feet, 4,879 pounds at 23 cents	$1,122.17
44,352 feet No. 10 at 55 pounds per thousand feet, 2,439 pounds at 23 cents	560.97
	$561.20

The additional cost of placing No. 6 wire will vary according to conditions. Consider, since the wires include wires cut in and run in stores, and No. 10 is considerably easier than No. 6 to run inside, that such saving be $22; total, $583.20.

The interest on $583 at 6 per cent., $34.98 per annum. The pulling up of wires, etc., and all pole depreciation, will be practically the same in either case, and the only question is, will the additional power lost cost $34.98 per year?

Possibly the pro rata cost of 1 h. p. delivered to the line may be three cents per horse power hour, but, in the problem under consideration the question is: How much more does it cost to deliver four (6.6 — 2.6) additional horse power to the dynamo? When the engine works within an economical range of cut-off, the only additional cost is that of fuel and, in some cases, water. The fuel may be, in the case taken, five pounds per horse power at $2.80 per ton. If such should be the case 5 (pounds) × 4 (h. p.) × 1,200 (hours) × 14 cents (per pound), $33.60, and the difference of $1.38 is so small that No. 6 would be used in order to allow an increase of lamps, if so desired.

If the fuel is cheaper than amount above specified, or the engine uses less fuel per horse power, it would be more economical to use No. 10 than No. 6 to an amount depending upon such lessened fuel cost. If fuel cost $1.80 per ton, the additional fuel would only cost $16.80, and $18.18 be saved by using No. 10 instead of No. 6 wire.

2. If the five lights are likely to be desired, it will evidently be advisable to use wire sufficiently large to make it possible to furnish the same, as the income will certainly amount to more than the additional cost of wire between the limits above considered.

Example.—What possible gain by using No. 4 instead of No. 6 wire?

No. 4—44,352 ft. at $1.65 per thousand; 7,318 at 23c	$1,683.14
No. 6—44,352 ft. at $1.10 " " 4,879 at 23c	1,122.17
	$560.97
Plus additional labor	20.00
Total	$580.97
Interest at 6%, $34.86.	

The possible increase of output is as follows:

As before, 74 volts will be needed for No. 6 wire. For No. 4 it will be as follows: ratio for No. 4, 44,352 feet at .25 of an ohm per thousand, 11.088; 111 volts, gain, 63 volts—one lamp and 13 volts—discarding the 13 volts* one arc lamp is gained.

Interest on wire	$34.86
Six per cent. interest on one arc lamp at $50	3.00
Five per cent. (f) rep. and dep. arc lamp	2.50
Average of one carbon each night (four hours) for 300 nights at $11 per thousand	3.30
Globes per annum	1.00
Labor trimming (possibly nothing)	10.00
Total	$54.66
Income at 40 cents (300 nights)	120.00
Balance	$85.34

It would, in such a case, be better to use No. 4 than No. 6.

If it is necessary to run a distance of 500 feet to obtain a customer for the extra lamp then the R of such extra 500 feet of No. 4 would be .125 ohm, requiring 1.25 volts additional. This is such a small amount that it need not be considered.

If such 500 feet has to be run on poles specially erected for such line, the interest and depreciation on the additional 500 feet must be subtracted from the balance of $85.34.

If the wire be a loop only two more poles may be needed.

500 feet No. 4 wire	$8.00
82½ pounds at 23 cents	18.97
	$26.97

Interest and depreciation at 10 per cent, $2.70.

In practice the most important points, in reaching out for such extra customer, would be as to whether he would be permanent, and if not, whether the first cost could be charged to customer.

If more arc dynamos than the above be installed, and there be a probability that they will not be used to nearly their full capacity, it might not pay to increase from No. 6 to No. 4 unless it was necessary or advisable to place the extra lights being considered on the circuits which shut down at the hour specified (10 P. M.), because the other dynamo circuits did not fulfill that condition; unless the other circuits did not run in the vicinity of any of the lights

* This illustration is an integral portion of the second paper on the most economical loss in conductors (THE ELECTRICAL WORLD, July 25, 1891).

* Actually the 13 volts gained at the dynamo saves 130 watts—.2 h. p. for 1,200 hours—240 h. p. hours at five pounds coal and .125 cent per pound—1,200 pounds, $1.50 saved in coal in one year.

on the circuits heretofore considered and therefore none could be "cut over" on such new circuits.

Probably the reader will wonder as to what light has been thrown on Sir Wm. Thomson's rule by the above lengthy dissertation. The answer is, possibly none, but it is hoped that light has been thrown upon the various questions considered and assistance been given as to how to proceed when cases of a similar nature arise in practice.

A review shows the cost per h. p. lost in the line to be a variable which can only be approximately determined after a full consideration of any given case. The cost per 1,000 lbs. of copper follows the same path. The desirability and possibility of obtaining additional income if an increased amount of electricity be deliverable to customers is only determinable approximately and is largely a matter of judgment. The following law is enunciated, and, although its truth has probably been recognized by many, it is believed that it is here presented for the first time. For a constant current circuit the interest on the difference of first cost in place between the wire chosen and the next smaller, plus the additional depreciation and repairs (if any) on same, plus the interest and depreciation and repairs on any additional line specially placed to operate translating devices using energy so saved, plus interest, depreciation and repairs on translating devices so installed, plus annual cost of maintenance (carbons, globes, trimmer's time, etc., for arc lamps; inspection for motors) should be exceeded by the additional income.

Telephone Cables.

BY HERBERT LAWS WEBB.

I greatly regret that my note* on the above subject should have caused any offense to Mr. Perrine. Nothing was further from my mind at the time of writing, the desire which prompted me to write being that erroneous statements should not go uncorrected.

I am still of the opinion that in comparing short lengths of line and cable KR does not hold good, the important consideration being the capacity.

I sincerely apologize for any wording in my note that Mr. Perrine has interpreted as impugning his honesty. The error in the original report arose, as he says, from an error in the stated length. As soon as I received the correct length an amended report of the test was furnished to Messrs. Roebling, giving the corrected insulation resistance, capacity and conductor resistance, the latter value being 34.95 ohms. That this report did not reach Mr. Perrine was through no fault of mine.

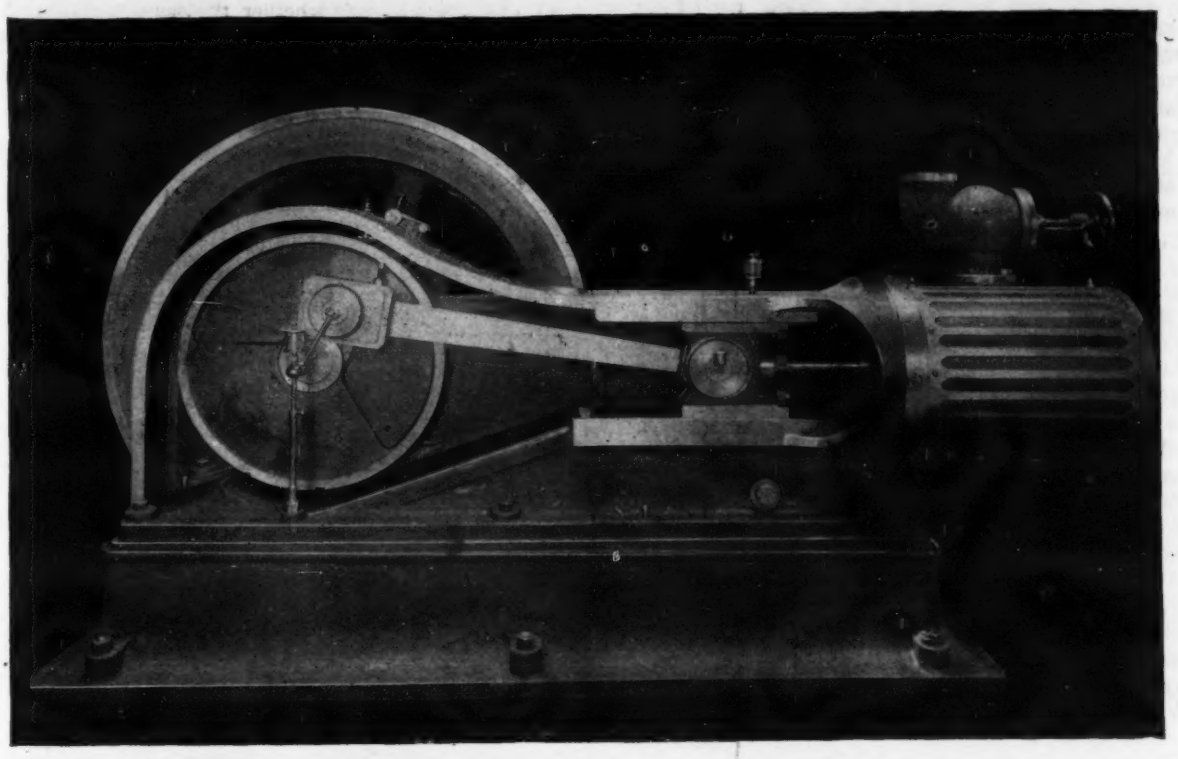
With regard to the galvanometer incident related by Mr. Perrine, nothing of the sort took place with the cable in question. The tests on the Roebling cable were made with the greatest care and accuracy, and all the measurements were checked by subsequent tests to make sure that the results obtained should be absolutely reliable. It is quite true that some time before this cable was laid one of my assistants had some trouble with his galvanometer when working at a downtown exchange where testing is always carried on under most adverse conditions, and that he took the instrument home with him at night to repair the suspension and examine the needles. I may have mentioned this incident to Mr. Perrine in conversation, but I scarcely thought to see it in print.

The correction in the KR of the 736 miles of cable is freely accepted, and after all the error is not a very serious one. When a thing is impossible, it does not so very much matter whether it is 100 times or merely eight times impossible.

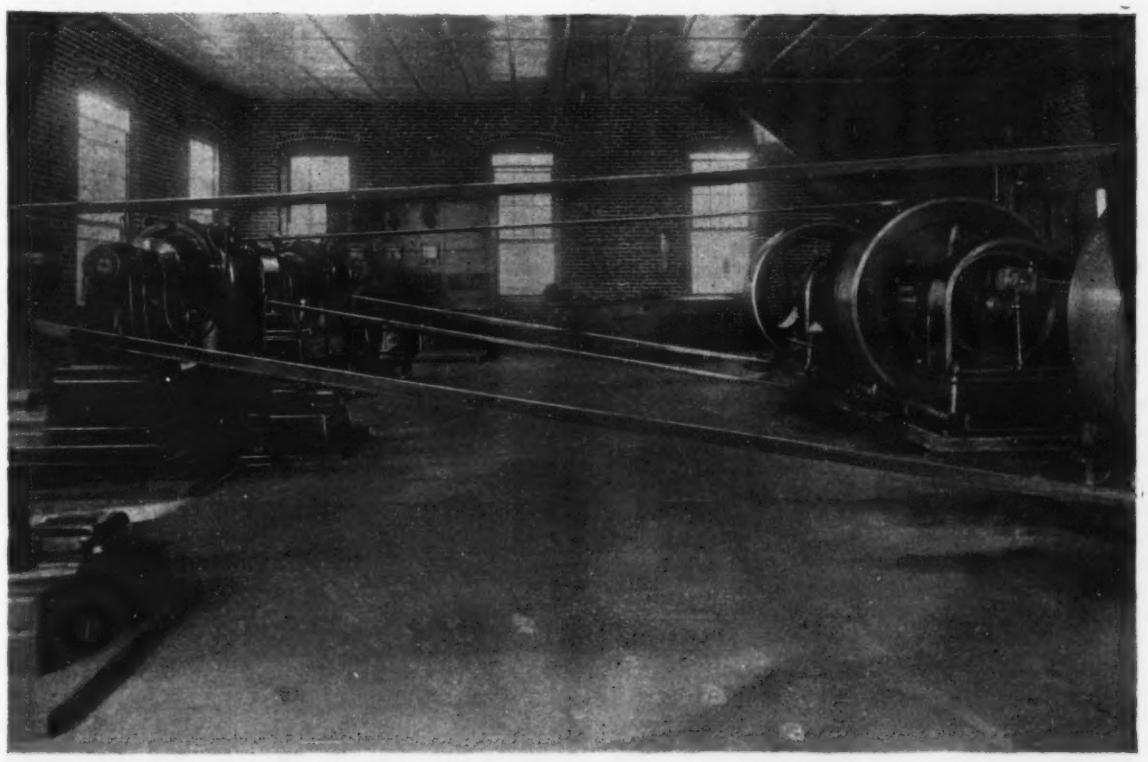
* For Mr. Webb's note see THE ELECTRICAL WORLD Aug. 15, 1891, and for Mr. Perrine's reply see THE ELECTRICAL WORLD of Aug. 22, 1891.

A New Type of Engine.

The accompanying illustrations show an engine designed by Mr. M. A. Green, of Altoona, Pa., for use in electric railway, lighting and welding work. As is well known and very generally recognized among engine builders, the work of operating a railway power station is one of the severest tests of an engine's endurance, because of the sudden and violent fluctuations of load. In this work the engine has proved entirely satisfactory. The different parts are of extra weight, the fly wheels alone each weighing 8,500 pounds. Two of these engines are in use at the factory of the Johnson Steel Rail Company, of Johnstown, Pa.; two more are in use in the Knoxville (Tenn.) railway plant, three are in service in the Altoona electric railway station, two are driving dynamos in the lighting plant of the Edison Electric Illuminating Company, of Altoona, Pa., and another is nearly ready at the Altoona Manufacturing Works.



THE GREEN ENGINE OF THE ALTOONA MANUFACTURING COMPANY.



THE GREEN ENGINE DRIVING RAILWAY GENERATORS.

The Story of a Strange Fault.*

A fault in a submarine cable has been brought to our notice lately which possesses some novelty and, at the same time, brings into view some historical features. Some quantity of small sized submarine cable was purchased a good many years ago in the United States by a Lancashire gentleman who owned some collieries. This cable was stated to have been originally made in England and shipped over to America. A quantity of it was bought by the gentleman we mention and shipped to Lancashire, where it has at times been used in various lengths and for various purposes, formerly for signaling, latterly for telephones, leaving a small surplus of between one and two miles. As some electric lighting had to be done recently about the colliery and the owner's house (the original proprietor who bought this cable has been dead for some time and exact records could not be obtained), it was suggested that some of this cable could be used for a portion of the work where the wires had to be carried underground. Messrs. Mercier, Corlett & Co., of Wigan, who had the work in hand, forwarded this cable to the works of Messrs. W. T. Glover & Co., of Salford, for examination, and repair if necessary.

The cable, in two lengths, both of which were placed in water, was carefully examined and kept there for some time. One piece was found perfectly sound nd tested well, giving a good insulation, while the other was found faulty with a "dead earth," which was easily localized.

The sound cable after being put into order for laying down, and the faulty piece, after the bad place had been cut out and the tests showed it again to be good, were sent away.

The cable was constructed with a conductor of 7-21 insulated with gutta-percha, served with jute yarn and armored with 18 No. 14¼ wires. The fault itself showed full earth, but no disconnection, and although the test for distance was correct no external signs could be seen to account for the fault. A piece about two yards in length, containing the fault, was cut out, and a portion of the armour taken off, so as to admit of the core being unlaid. On removing the core it suddenly came away clean cut through serving, insulation and conductor, the division being perfectly clean and smooth, and evidently cut by a sharp instrument. On replacing the core exactly as it was originally, and then restoring the armor to its place, it was found on close examination that there was a slight opening between two wires corresponding with the cut. This was evidently caused by a fine sharp narrow chisel, or a similar tool which had been placed between the wires and driven through the core until it was stopped by the iron wires on the reverse side.

This cable, from the original statement, was purchased in England in 1861, and believed to be made by Glass, Elliot & Co., was shipped to the United States for some special purpose. As the civil war in America broke out in that year, it is not unreasonable to suppose that this cable was employed during the war for either telegraphic, torpedo, or mining purposes, by either one side or the other, and that the special section now referred to was in operation. The damage would be probably done by one of the opposing sides, so as to effectually destroy the communication without giving any external signs that the cable was damaged. This supposition appears to be the only one to account for a fault of this character. There is no doubt but that this cable was in the United States during the time of the war. From further inquiries made, it has been ascertained that a cable of this precise type was made in 1861 by Glass, Elliot & Co., for some repairs to the Red Sea cable. This cable, about 200 miles in length, was sent out, but all came back again and was brought to their works at Greenwich, but beyond that we have not been able to obtain definite information. However, the type of cable and its characteristics speak for themselves, and there can be no question but that it was originally made in 1861, underwent many vicissitudes in the United States, and finally returned to England, where, for many years, it remained stowed away in the works connected with a colliery. That it was used in the American war we have no absolute proof, beyond the fact that it was in the States at the time, and from the nature of the fault, which was clearly malicious.

The sections to which we have referred gave good tests as to insulation, and as the thickness of the dielectric was one-tenth inch, it was considered safe to place them underground in connection with an electric light circuit. These cables are now working satisfactorily, with an alternating current of 2,000 volts.

The fault itself is now in the possession of Mr. W. H. Preece, F. R. S., at the General Post Office, having been placed in his hands by the writer, who has had in the past an extensive experience of cable faults.

* From the *Electrical Review* (London).

The Elements of Practical Electricity.

BY DR. LOUIS BELL.

It is a strange fact that the history of practical electricity up to the present time is very nearly bounded by the century in which we live. Strange it is, because for more than twenty centuries some of the phenomena of electricity had been well known, and not a few of them had by the latter half of the eighteenth century been rather carefully investigated. Besides this we now know that instead of its being in any sense difficult to call into action that unknown but not unknowable something that is called electricity, it is far from a hard task. We shall see later that electrical energy appears in every mechanical change and every transformation of energy throughout all its protean forms. Because the amount of electrical effect produced under ordinary circumstances is not large, and because the natural sources of electricity, in quantity, are few, the world remained very long in the dark concerning the powerful agent now at its command. Aside from lightning, always the most intense and terrific manifestation of electrical energy, very small amounts of electricity ordinarily appear in the course of nature's operations. The most noteworthy exceptions may be found in the case of a few electrical fishes. These singular creatures were known to the early Greek philosophers from their peculiar power of giving to the hand that would touch them a shock powerful enough to benumb it. From this strange power the best known of the electrical fishes, a species of ray common along the shores of the Mediterranean, acquired the name of "torpedo," from the Latin word *torpeo*, to benumb, by which it is known at the present day. Several others of the finny tribe have the same power in a greater or less degree. It is interesting to note that as these animal organisms furnished the most powerful supply of electricity known in early times, so in a somewhat roundabout way the investigation of animal physiology led to the most noteworthy investigations and discoveries of the present day. The real beginning of practical electricity dates, however, only so far back as the year 1800, and it is with the momentous work thus initiated that the present series of papers begins.

The discovery of a practical means of producing electrical energy in quantity was not the result of chance: it was the product of years of patient training and investigation. The

Fig. 1.—Alessandro Volta.

place was a little village near Milan; the time, during the first few days of the year 1800; and Alessandro Volta, then 55 years old and for more than 20 years professor of natural philosophy in the University of Pavia, was the man to whom modern electricity owes its first powerful influence. On the 20th of March, 1800, he wrote a letter to Sir Joseph Banks, president of the famous Royal Society of London, describing the invention of the first electric battery. Twenty years before, Aloysius Galvani, professor of anatomy in the University of Bologna, had discovered that with the feeble means of exciting electricity then at the command of the scientific world it was possible to produce muscular contractions of the most striking character; he had followed the line of research thus marked out, and had found that extraordinary physiological effects could also be produced by very simple means of a kind quite unlike those ordinarily employed for producing electricity. He had become involved in a prolonged discussion with Volta as to the cause of the phenomena observed, and the outcome was that I have just mentioned. Volta's discovery, in brief, was this: that if two bits of metal of different kinds are placed on opposite sides of a piece of moistened cloth or paper, they become capable of producing electrical action by simple connection—best by metallic substances—through anything that is adapted to show its presence.

The Voltaic Pile.

Perhaps the clearest idea of what this discovery meant may be obtained by constructing Volta's apparatus in very nearly the form in which it was described in his famous letter. It is worth while for those interested in following out the subject thoroughly to try the experiment. Procure a piece of thin copper, untinned, 20 inches long and 14 inches wide, a piece of thin sheet zinc of the same dimensions, and the thinner the metals the more easy it is to construct the apparatus neatly. Divide these two pieces of metal into 2-inch squares, and cut them up. You will then have 70 zinc and 70 copper plates, each two inches square. It is best to clean both zinc and copper, before cutting, by rubbing with sand-paper or emery-paper on both sides. Now cut out of cotton cloth 70 pieces, also two inches square, and lay them aside for further use. Next cut out of inch board two blocks about 4 inches square, and procure four round sticks a quarter of an inch in diameter and 8

Fig. 3.—The Voltaic Battery.

or 10 inches long; lay one of the metallic squares upon one of the blocks, centering it carefully with the sides of the two parallel; then make a dot with a pencil at the centre of each side of the metal square and one-eighth of an inch from it. With a ¼-inch bit bore four holes at the places thus marked, and, with these as guides, bore corresponding holes in the other block. Set the four sticks upright in one of the blocks. You are now ready to go ahead with the construction of a voltaic pile, somewhat more neat and powerful than those originally made by Volta, but in substance very nearly the same. Prepare a dish of strong brine and soak your pieces of cloth thoroughly in it, leaving them there until used. Now lay upon the block one of the square bits of copper, to the corner of which you have soldered a small copper wire or strip; lay upon this one of the pieces of wet cloth, then a zinc plate, then a copper plate, another piece of cloth, and so on, piling up the plates and cloth in this order until finally the metallic plates are all used, when a zinc plate will be on the top of the pile. This zinc plate should have a wire or strip soldered to it, as in the case of the companion plate at the bottom. If the blocks and plates have been neatly arranged the latter will fit nicely into the place between the four rods, so that everything will remain firmly in position; then push the second block down upon the rods so as to force the pile of plates into good contact. Fig. 2 shows the completed pile. By wetting the fingers and grasping the wires at the top and bottom of the pile, one with either hand, you will become very definitely aware of the practical character of Volta's discovery. If the pile is carefully put together and the cloth squares have been thoroughly wetted the resulting shock will probably be felt clear to the shoulders. If a smaller number of pairs of metallic plates are employed the shock will be correspondingly less severe, but the apparatus is quite powerful enough, however, to demonstrate its ability to produce very decided sensations. If this voltaic pile be composed of only a single pair of copper and zinc plates with the wetted cloth between them, and the wires leading therefrom are placed on opposite sides of the tongue, no shock will be received, but you will feel a peculiar biting sensation that is very characteristic of an electrical current, by which I mean the passage of electrical energy that takes place between such a pair of plates when they are connected outside of the cloth by any conducting substance. What is meant by a conducting substance can be very readily appreciated by a few experiments with the pile. Using only three or four pairs of plates, place the wire from the plate at either end of the pile on one side of the tongue and make connection with the other side from the other terminal plate of the pile by means of a string or piece of wood; no sensation aside from a possible slight taste of the copper wire will be felt. By using a few more pairs of plates and wetting the string used to connect with the tongue, even with pure water, you will soon perceive that, whereas the dry string did not convey any electrical current from the pile, the wet string is quite capable of doing so. In this way one might go on indefinitely, trying the power of various substances to convey to and through the tongue whatever it is that under such circumstances can pass from one end of the pile to the other. In experimenting with a large number of such substances you would very soon find that all metals convey the current in such a way that it can be very plainly tasted. With the same number of plates, wood, paper, glass and such like substances convey no electrical effect; while a wet string, whatever the liquid with which it is saturated, is capable of doing so, but in a less degree than metals. This much can be readily found out with Volta's simple apparatus, using the tongue as an indicator of the passage of current. If one were to make a list of substances which can and can not convey the electric current well, the former would include all the metals, the latter all dry, non-metallic substances; while between the two in power of conduction would be most liquids, and substances wet with liquids. The very simplest way of experiencing the sensation due to electrical current, even simpler than the pile just described, is one due to Volta himself. He tried the following experiment: On the tip of his tongue he placed a strip of tinfoil, and then, putting the convex part of a silver spoon farther back on the flat part of the tongue, he tipped the spoon until the handle came in contact with the foil; the result was a sharp taste of a character surprising to the experimenter. He had expected some of the muscular movements noticed by Galvani to follow, and, indeed, tried the experiment in front of a looking glass to see the result. On a little reflection, however, he realized that the nerves at the tip of the tongues are nerves of taste and do not control movement. The electric current that passed had excited the nerves, but not the particular ones he anticipated. In experimenting with the voltaic pile one very soon finds that its power begins to fall off as the moisture evaporates from the separating bits of cloth; for this reason it is most convenient to experiment with only a few pairs of plates, so that the pile can be taken apart and the cloth remoistened. Volta appreciated this fact very soon after he constructed his pile, and, in the same famous letter I have mentioned, he describes a more convenient method of setting up his apparatus for the purpose of continuous experimenting.

The Voltaic Battery.

This is well shown in Fig. 3, and really constitutes quite a effective battery. It may be readily constructed from the same plates used in the previous experiments. To do this, solder the plates in pairs, copper and zinc, to the ends of pieces of copper wire five or six inches long. The wire should preferably be rather coarse, so as to stay bent and hold the plates in position. Bend up the wire into a loop, as shown in the cut, and place the plates in a series of tumblers, as many as you happen to have convenient; arrange them in neat order with the metal plates about a quarter of an inch apart. If the connecting wires are stiff this will be easy and the plates will stay where they are put. Then fill the glasses nearly to the top of the plates with brine, or, far better, water to which has been added about one-thirtieth of its bulk of sulphuric acid. In making this mixture, by the way, always pour the acid into the water and never the water on the acid,

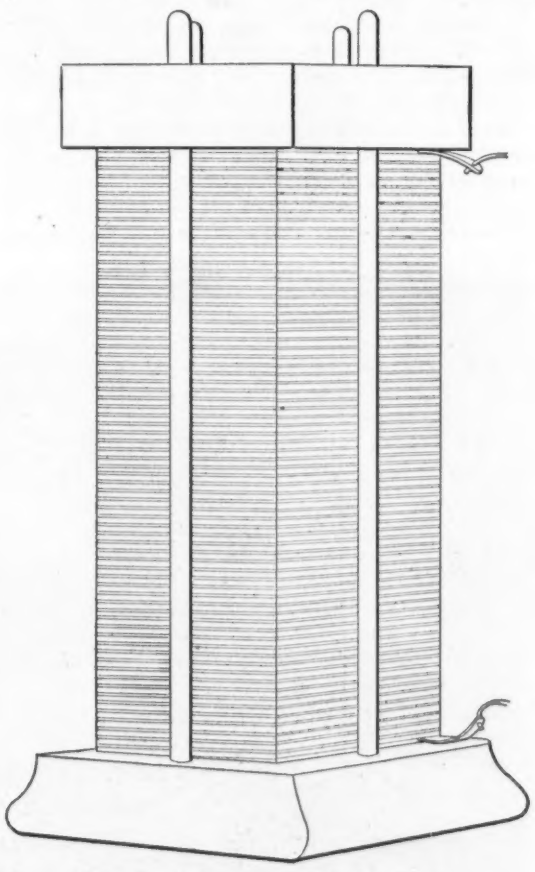


Fig. 2.—Completed Voltaic Pile.

and stir the mixture with a stick, carefully avoiding getting it on the hands or clothes, as if it falls on the latter it is certain to injure the fabric. With a rudimentary battery of this kind the same experiments as to taste and even shock, can be carried out as with the voltaic pile, and rather more definitely. Its power, however, will be somewhat diminished by continued use, and after a while you will notice fine bubbles collecting on the copper plates; these shield part of the surface and interfere with the action of the battery, but can be temporarily removed by shaking the plate slightly. This original voltaic battery is not at all to be despised on account of its simplicity, for with it, or very slight modifications of it, a considerable number of important discoveries were made, and it remained the best source of electrical current for many years. One large battery constructed on this plan, and celebrated in the annals of science for the remarkable experiments that were performed with it, contained no less than 2,000 pairs of plates, each four inches square.

In this initial paper I have simply endeavored to present to the mind the story of the beginning of practical experiments on electricity, and to show how in the very simplest

way considerable effects can be produced, and, what is most important, that bodies may, even by these very rudimentary experiments, be divided quite effectively into conductors, poor conductors and non-conductors.

(To be continued.)

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1762.——Sulzer (Johann Georg), a Swiss philosopher, member of the Berlin Academy of Sciences, in his "Theory of Agreeable and Disagreeable Sensations" ("Theorie d. angenehmen v. unangenehmen Empfindungen"), Berlin, 1762, thus expresses himself: "When two pieces of metal, one of lead and the other of silver, are so joined together that their edges make one surface, a certain sensation will be produced on applying it to the tongue, which comes near to the taste of martial vitriol (vitriol of iron); whereas each piece by itself betrays not the slightest trace of that taste." (F. C. Bakewell, "Manual of Electricity," London, 1857. chapter III., p. 28.)

The passage in the edition "Nouvelle Théorie des Plaisirs," published in Berlin, 1767, is thus given by Sabine, "Electric Telegraph," 1872, p. 15: On taking two pieces of different metals—silver and zinc—and placing one of them above and the other underneath his tongue, he found that, so long as the metals did not make contact with each other, he felt nothing; but that when the edges were brought together over the tip of his tongue, the moment contact took place and during the time it lasted, he experienced an itching sensation and a taste resembling that of sulphate of iron. . . . Sulzer does not appear to have been much surprised at the result, thinking it "not improbable that, by the combination of the two metals, a solution of either of them may have taken place, in consequence of which the dissolved particles penetrate into the tongue; or we may conjecture that the combination of these metals occasions a trembling motion in their respective particles, which, exciting the nerves of the tongue, causes that peculiar sensation."

And thus, remarks Pepper, a prominent fact has slept in obscurity from the time of Sulzer to the time of Galvani.

See Izarn, "Manuel," Paris, 1804, p. 4; Sturgeon, *Annals*, vol. VIII., p. 363; also note at page 491 of Ronalds' Catalogue; *Mém. de l'Acad. de Berlin*, "Théorie Générale du Plaisir"; also "Temple du Bonheur," published at Bouillon (Pays Bas), 1769, tome III., page 124, this last named work being alluded to in the *Journal des Débats*, 7 Vendiémaire an. X.

A. D. 1762.——Comus (Ledru), French professor of natural philosophy, invents a mode of telegraphing which is described and fully illustrated at page 17, vol. I., of Guyot's *Nouvelles Récréations Physiques et Mathématiques*, Paris, 1769; as well as at page 278 of *Mémoires, Correspondance et Ouvrages Inédits de Diderot*, Paris, 1821, in one of the letters to Mlle. Voland dated July 28, 1762.

His apparatus is said to have consisted of two dials, each bearing upon it twenty-five letters of the alphabet, which were moved by the agency of magnets and of magnetized needles; but Auguste Guérout considers the contrivance to have been merely a speculative one, as will be seen by his article, reproduced from *La Lumière Electrique*, in No. 384 of the "Scientific American Supplement."

See, also, *Journal de Physique* for 1775 (vols. V. and VI.), for 1776 (vol. VII.) and for 1778 (vol. I.); "Scelta d'Opuscoli," Milano, 1776.

A. D. 1765.——Cigna (Giovanni Francesco), native of Mondovi, Italy, and nephew to the electrician Beccaria (A. D. 1753), became Secretary to the society of savans who gave birth to the Royal Academy of Sciences at Turin, and whose Memoirs contain his work, "De novis quibusdam experimentis electricis," 1765.

At pages 31-65 of the above Memoirs is given a full account of Cigna's many curious observations made with silk ribbons in various positions, and in contact with different surfaces, instead of with the silk stockings employed by Symmer (A. D. 1759), whereby he supplies the main defect of Dufay's theory (A. D. 1733), by proving that the two opposite electricities are produced simultaneously.

See also page 47 of the same work, for a report of Cigna's experiment with ice, to ascertain whether electric substances contain more electric matter than other bodies, and see page 168, vol. III., of Nollet's "Letters," for an account of his observations upon the electric attraction and repulsion between conducting substances immersed in oil, as well as chapter II., section III., vol. I., of Van Swinden's "Receuil, etc.," published at La Haye, 1784.

See, likewise, Cigna's Memoirs on Electricity and Magnetism in the "Miscellanea . . . Taurinensia," and the several communications made by him to Priestley, Lagrange and others in 1775, concerning Volta's electrophorus; also "Memorie istorische . . . di Gianfrancesco Cigna de Antonmaria Vassalli Eandi," Torino, 1821.

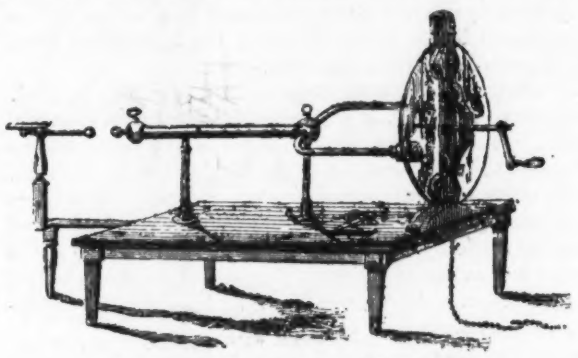
A. D. 1766–1776.——Lambert (Johann Heinrich), a profound German mathematician, native of Upper Alsace, publishes in vol. XXII. of the Reports of the Berlin Academy two beautiful Memoirs upon the Laws of Magnetic Force and upon the Curvature of the Magnetic Current, both of which, Dr. Robison says, would have done credit to Newton himself.

*Continued from THE ELECTRICAL WORLD, Aug. 29, 1891.

In the first Memoir, says Harris, the author endeavors to determine two very important laws; one relating to the change of force as depending upon the obliquity of its application, the other as referred to the distance. In the second Memoir the curves of the magnetic current are investigated by the action of the directive or polar force of a magnet upon a small needle. Lambert concludes that the effect of each particle of the magnet on each particle of the needle, and reciprocally, is as the absolute force or magnetic intensity of the particles directly, and as the squares of the distances inversely.

Wood states ("Manual," London, 1859, page 580) that Lambert's deductions were confirmed twenty years later by Coulomb, through the agency of his delicate torsion balance, and more recently (about the year 1817) by Prof. Hansteen, of Christiania.

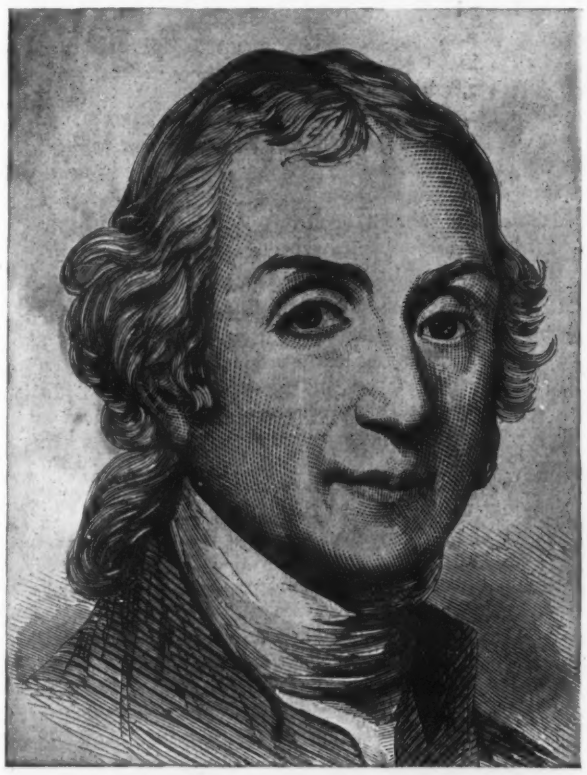
Previous to the above named date, in 1760, Lambert had published, both at Leipsic and at Augsburg, his "Photometria, sive de Mensura et Gradibus Luminis, Colorum et



RAMSDEN'S ELECTRICAL MACHINE.

Umbræ," the sequel to a tract printed two years before, wherein he indicates the mode of measuring the intensity of the light of various bodies. The celebrated mathematician and astronomer, Pierre Bouguer (1698–1758), who had published, in 1729, his "Essai d'Optique, etc.," which was greatly enlarged in his "Traité, etc.," brought out by La Caille in 1760, may be considered the founder of this branch of the science of optics, to which the name *photometry* has been given by English writers. The photometer designed by Sir Benjamin Thompson, *Count Rumford* (entered at A. D. 1802), has been described in *Phil. Trans.* for 1794, vol. LXVII. His method is to cast two shadows of a given object near each other on the same surface, the lights being removed to such distances that the shadows appear equally dark.

See Sir John Leslie's "Fifth Dissertation" in the eighth "Encyclopædia Britannica": Count Rumford's photometer



REV. JOSEPH PRIESTLEY.

illustrated at plate XXVII., Figs. 387, 388, vol. I., of Dr. Thomas Young's "Course of Lectures," London, 1807, also pages 282 and 351, vol. II., of the same work, concerning photometry generally; Dredge and others, "Electric Illumination, etc." (chiefly compiled from London *Engineering*), vol. II., pages 101–117. See, likewise, Brewster's "Edinb. Jour. of Sc.," 1826, vol. II., p. 321; vol. III., p. 104; vol. V., p. 139, for William Ritchie's articles on the photometer of Mr. Leslie, and relative to an improved instrument upon the principles of Bouguer (*Edinb. Transactions*, vol. X., pt. 2); Lambert's biography and the article "Magnetism" in the "Encycl. Britan."; Harris, "Rudim. Magn.," part III., pp. 20, 33, 191–203.

It may be added that all the valuable manuscripts left by Lambert were purchased by the Berlin Academy, and were afterward published by John Bernoulli, a grandson of the celebrated John Bernoulli alluded to at A. D. 1700.

A. D. 1766.——Lullin (Amadeus), in his "Dissertatio physica de electricitate," Geneva, 1766, at page 26, alludes to Beccaria's experiments, saying that he produced much greater effects with the electric spark by passing the latter through oil instead of water: oil being a much worse conductor, the spark in it is larger. At page 38 of the same work he details the experiments made to prove conclusively the correctness of the doctrine which Nollet entertained regarding the constant motion of electrical atmospheres, and, at page 42 are given his experiments to show the production of electricity in the clouds. With a long insulated pole projecting from the mountain side, he observed, among other effects, that when small clouds of vapor produced by the sun's heat touched only the end of the pole the latter was electrified, but that it was not affected if the entire pole was covered by the vapor. ("Lib. Useful Knowledge," Electricity, chapter XI., Nos. 154, etc.)

Lullin, it is said, proposed a modification of Reusser's plan of telegraphing, as stated at page 69 of Reid's 1887 "Telegraph in America."

A. D. 1766.——L'Abbé Poncelet, a native of Verdun, France, publishes at Paris "La Nature dans la formation du Tonnerre, etc.," wherein he indicates a method of protecting from lightning residences, pavilions and other structures, by constructing them of resinous woods and lining them with either silk or waxed cloths. He remarks that as they thus present "on all sides resinous surfaces, which never receive phlogiston by communication, the latter (thunder and lightning), after having leaped lightly around the pavilion and finding itself unable to attack it, will probably depart in order to pursue its ravages elsewhere."

See *Scientific American Supplement*, No. 66, p. 1,053, for a copy of the frontispiece of the above named work; also, Figuier, "Exposition et Histoire, etc.," 1857, vol. 4, pp. 234, 235.

A. D. 1767.——Bozolus (Joseph), an Italian Jesuit, professor of natural philosophy at Rome, is the first (and not Cavallo—A. D. 1775) to suggest employing the active principle of the Leyden jar for the transmission of intelligence.

His plan is to place underground two wires which are to be brought at each station close enough together to admit of the passage of a spark. One wire is to be connected with the inner coating and the other with the outer surface of a Leyden phial; the sparks being observed at the opening between the wires, where they can be made to express any meaning according to a preconcerted code of signals.

See Latin poem entitled "Mariani Parthenii Electricorum," in six books, Roma, 1767, liber 1, p. 34 (describing the *telegrafo elettrico scintillante*); also *Saturday Review*, August 21, 1858, p. 190, and *Cornhill Magazine* for 1860, vol. II., p. 66.

A. D. 1767.——Priestley (Joseph), the earliest historian of electrical science, publishes, by advice of Benjamin Franklin, the first edition of his great work, "The History and Present State of Electricity," in 1767. During the previous year he had been given the degree of Doctor of Laws by the Edinburgh University and he had also, at the instance of Franklin, Watson and others, been made a member of the English Royal Society, which, a few years later, bestowed upon him the Copley Medal.

Speaking of the above named work, Dr. Lardner says ("Lectures," 1859, vol. I., p. 136), "This philosopher did not contribute materially to the advancement of the science by the development of any new facts; but, in his 'History of Electricity' he collected and arranged much useful information respecting the progress of the science." Nevertheless, to him is due the first employment of the conductor supported by an insulating pillar, as described by Noad, who gives an account of Priestley's electrical machine at chapter IV. of his "Manual," and he is also the first to investigate upon an extensive scale the chemical effects of ordinary electricity. The observations of Mr. Warltire, lecturer on natural philosophy, and his own experiments in this line, by passing the electric spark through water tinged blue by litmus, through olive oil, turpentine, etc., as well as his experiments more particularly upon the gases and upon the influence of electricity in expanding solid bodies, are detailed at the "Electricity" chapter of the "Encycl. Britannica."

At pages 660–665 of the fourth edition of his "History," Priestley describes the experiments he made to illustrate what he called the *lateral force of electrical explosions;* that is, the tendency of the electric fluid to diverge, as is done by lightning whenever any material obstruction lies in its path.

The most important of all Dr. Priestley's electrical discoveries (Thomson, "Hist. Roy. Soc.," p. 445) was that charcoal is a conductor of electricity, and so good a conductor that it vies even with the metals themselves. This is a curious and unexpected analogy between the metals and charcoal, and chemistry furnishes us with several others no less striking and important. When the conducting power of charcoal was tried by succeeding electricians, it was found to vary in the most unaccountable manner, sometimes scarcely conducting at all, sometimes imperfectly and sometimes remarkably well. This diversity indicates a difference in the nature of different specimens of charcoal. Hence we may be assured that charcoal is a compound, and that it often varies in the proportion of some one or other of its ingredients. (See Priestley's "History, etc.," section III., part VIII.) Charcoal being examined by Mr. Kennersley, was found to vary in its conducting power. Oak, beech and maple charcoal he found to con-

duct satisfactorily ; but the charcoal from the pine would not conduct at all, while a line drawn upon paper by a black lead pencil conducted pretty well. (*Phil. Trans.*, 1773, vol. LXIII., p. 38.)

See Priestley's letter to Dr. Franklin (*Phil. Trans.*, vol. LXII., p. 360) concerning William Henley's new electrometer and experiments; "Trans. of the Amer. Phil. Soc.," O. S., vol. VI., part I., page 190, containing proceedings of the Society on the death of Joseph Priestley; Wilkinson's "Elements of Galvanism, etc.," London, 1804, vol. II., pp. 74–80; Noad's Lectures, number IV., Knight's edition, pp. 182, 183; "Library of Useful Knowledge," London, 1829, chapter "Electricity," pp. 41 and 45; Warltire, in Muirhead's translation of Arago's "Eloge de James Watt," pp. 99, 100; also the appendix of the last named work, page 157 and note.

A. D. 1767.——Lane (Thomas—Timothy), a medical practitioner of London, introduces his discharging electrometer, which is now to be found described and illustrated in nearly all works on electricity.

It consists of a bent glass arm, one end of which is attached to a socket in the wire of the Leyden jar, the other end carrying a horizontal sliding brass rod, or spring tube, which bears a ball at each extremity. The rod is usually divided into inches and tenths, and regulates the strength of the charge ; or rather, indicates the force of the discharge which takes place when the knob of the jar is placed in contact with the prime conductor of an electrical machine, and the charge is strong enough to leap from one to the other.

In experiments made by Mr. Lane, the shocks were twice as frequent when the interval between the balls was one twenty-fourth of an inch as when twice as much; hence he concluded that the quantity of electricity required for a discharge is in exact proportion to the distance between the surfaces of the balls. The indications of this apparatus are, however, likely to be defective in consequence of the possible accumulation of light particles of dust or of other conducting material, as well as by reason of the variable state of the atmosphere, which affects its conducting power, and of the tarnishing of the metallic surfaces produced by frequent electric explosions.

A combination of the Lane and other electrometers was made by Mr. Cuthbertson, as shown at p. 528, vol. II., of *Nicholson's Journal of Natural Philosophy*, and at p. 451, vol. LVII., of the *Philosophical Transactions.*

See, also, the *Phil. Trans.* for 1805; *Monthly Magazine*, December, 1805, and *Tilloch's Philosophical Magazine*, vol. XXIII., p. 253.

A. D. 1768.——Ramsden (Jesse), a very capable English manufacturer of mechanical instruments, member of the Royal Society and of the Imperial Academy of St. Petersburg, is said to be the first to construct an electrical machine wherein a plate of glass is substituted for the glass globe of Newton and of Hauksbee. The same claim which has been made for Martin de Planta, Swiss natural philosopher, appears to have no foundation.

See *Journal des Savants*, November, 1788, p. 744; *Phil. Trans.*, 1783; "Chambers' Encyclopædia," 1868, vol. III., p. 812; Mme. Le Breton, "Hist. et app. de l'Electricité," Paris, 1884, pp. 61, 62.

The Construction and Maintenance of Underground Circuits.

BY S. B. FOWLER.

The numerous disastrous storms of the last winter have brought out very vividly the advantages of having all wires placed underground, and many inquiries have been addressed to the companies operating underground circuits as to their success. It is not probable that all of the answers to these inquiries have been of the most favorable character. To many central station managers an underground system means frequent break downs and interruptions of service, with perhaps slow and expensive repairs, which bring in their turn numerous complaints, loss of customers, and reduced profits. In many installations burn-outs both underground and in the station are frequent, with the natural result that the operating of circuits underground is not there considered an unqualified success. The writer has in mind two very different experiences with underground cables. Several miles of cable were bought by a certain company, carefully laid, and up to to-day not a single burn-out or interruption of service can be attributed to failure of cables; at about the same time another company bought about an equal amount of the same kind of cable and in a comparatively short time the current had to be shut off the lines and the whole installation repaired and parts of it replaced. Both of these experiences have been repeated many times and will be again, although it is simply a distinction between a good cable properly laid and a good cable ruined by careless and incompetent workmanship.

Every failure can be traced to poor work in the original installation or to the use of a cheap cable, both causes being due, generally, to that false economy which looks for too quick returns. A poorly insulated line wire and a poorly insulated cable are two very different things. However, it is a fact that by the use of a good cable it is not difficult to construct an underground system for light, power, telegraph or telephone uses that will be superior to overhead lines in its service and in cost of maintenance. The ideal underground system must have as a starting point a system of subways admitting of the easy drawing in and out of cables and affording means of making subsidiary connections readily and with the minimum of expense and interruption of service. This is practically accomplished by a subway consisting of lines of pipe terminating at convenient intervals, say at street intersections, in manholes, for convenience in jointing and in running out house connections. These pipes, or ducts as they are called, should be for two kinds of service; the lower or deeper laid lines for the main or trunk circuits, and a second series of ducts laid nearer the surface, running into service boxes placed near together for lines to "house to house" connections. In some cities where it is allowed to run overhead lines, the plan of running but one service connection in a block is followed, all customers in the block being supplied from a line run over the housetops or strung on the rear walls.

This makes unnecessary all subsidiary ducts except a short one from the manhole to the nearest building in the block, and effects a considerable saving in pipe, service boxes, cables and labor. The manholes should have their walls built up of brick, the floors should be of concrete, and there should be an inside lid which can be fastened down and the manhole thus made water-tight.

For ducts wood, iron or cement lined pipe may be used. To preserve the wood it is generally treated with creosote, which, in contact with the lead cover of the cable, sets up a chemical action, resulting in the destruction of the lead. Wood offers but little protection for the cable, as it is too easily damaged and broken through in the frequent street openings made by companies operating lines of pipe in the streets, and as one of the main purposes of a subway is that of a protection to cables, wooden ducts have little to recommend them except their cheapness.

Iron pipes are either laid in trenches filled in with earth or are laid in cement. Iron pipe will of course rust out in time, and if absolute permanence in construction is desired, should be laid in cement, for after the pipe rusts out the duct of cement is still left. However, if we are going to the expense of laying in cement it would be much preferable to use cement lined pipe, which is not only cheaper than iron pipe but makes the most perfect cable conduit, as it affords a perfectly smooth surface to draw the cable over and give a good duct edge.

It is not necessary, however, in small installations of cable, especially where additional connections will not be of frequent occurrence, to go the expense of subways, for cable may be safely laid in the ground in trenches filled in with earth, or can be inclosed in a plain wooden box or a wooden box filled with pitch.

There are, of course, many localities where, if the cable is laid in contact with the earth, a chemical action would take place which might result in the destruction of the cable.

Underground cables are of the following classes: 1. Rubber insulated cables, insulated with rubber or other homogeneous material. 2. Fibrous cables, so called from the conductors being covered with some fibrous material, as cotton or paper, which is saturated with the insulating material, paraffine, rosin oil, or some special compound. Under this latter head is also included the dry core paper cables.

The first thing to do is to get the cable drawn into the ducts, and on the proper accomplishment of this depends to a great extent the success or failure of the whole installation. Probably the ducts have been wired when the subway was constructed, but if not a wire must be run through as a means of pulling in the draw rope. There are several kinds of apparatus for getting a wire through a duct; rods, flexible tapes, mechanical "creepers," etc., etc.; but probably the best is the sectional rod. This simply consists of three or four foot lengths of hard wood rods, having metal tips that screw into each other. A rod is placed in a duct at a manhole, one screwed to that, both are pushed forward, another one added and pushed forward, and so on until they extend the entire length of the duct. Then the wire is attached and the rods are pulled out and detached one at a time and with the last rod the wire is through. At least No. 14 galvanized iron or steel wire should be used, for any smaller size cannot be used a second time, as a rule. In starting to pull in the draw rope a wire brush should be attached to the wire and to this again the rope, and when the brush arrives at the distant end of the duct it very likely will bring with it a miscellaneous collection of material which for the good of the cable had better be in the manhole than in the duct.

The reel or drum carrying the cable should be mounted on wheels or jacks and placed on the same side of the manhole as the duct into which the cable is to be drawn, and must always be so placed that the cable will run off the top of the reel.

There are several methods of attaching the draw rope to the cable. As simple and strong a method as any is to punch two or these holes through the cable, lead and all, and attach the rope by means of an iron wire—some of the draw wire will do—run through these holes. Depending on the length and weight of cable to be pulled it can be drawn either by hand or by a multiplying winch. The rope should run through a block fastened in the manhole in such a position that the rope shall have a good straightaway lead from the mouth of the duct.

The strain on the cable should be perfectly uniform and steady ; if the power is applied by a series of jerks either the lead covering may be pulled apart or some of the conductors broken. At the reel there must always be a large enough number of men to turn it and keep the cable from rubbing on anything, and in the manhole one or more men to see that the cable feeds into the duct straight and to guide it if necessary. If the ducts are of iron and are not perfectly smooth at the ends, these should be made so with a file, and in addition a protector of some sort should be placed in the mouths of the duct, both above and below the cable. Six inches of lead pipe, split lengthwise and bent over at one end to prevent being drawn into the duct with the cable, makes a very good protector. The cable should be reeled off the drum just fast enough to prevent any of the power used in pulling the cable through the duct being utilized in unreeling it. If this latter is allowed to occur the cable will be bent too short and the lead covering buckled or broken, and also the cable may be jammed against the upper edge of the duct and perhaps cut through. If the reel is allowed to turn faster than the cable is drawn in the first three or four turns on the reel will slacken up, and the lead covering may either be dented or cut through by scraping on the ground. If the cable end when pulled through up to the block is not long enough to bend around the hole more than half way, the rope should be unfastened from its end, a length of rope with a well frayed out end should be run through the block, and by fastening to the cable close to the duct, with a series of half hitches as much slack as necessary can be pulled in. If this is properly manipulated there need not be a scratch on the cable, but unless great care is taken the lead may be pressed up into ridges and the core itself damaged. Immediately after the cable is drawn in, if the joint is not to be at once made, the open end or ends should be cut off and the cable soldered up, as most cables are very susceptible to moisture and readily absorb water even from the atmosphere. Where practicable it is always a good plan to pull the cable through as many manholes as possible without cutting the cable; for the joint is, especially in telephone or telegraph cables, the weak point. To do this the rope should be pulled through the proper duct in the next section without unfastening it from the cable; the winch should be moved to the next manhole, and pulling through then done as before. There should always be a man in every hole through which the cable is running to see that it does not bind anywhere and to keep protectors around the cable. It is not advisable to pull more than one cable into a duct, and never advisable to pull a cable into a duct containing another cable, but if two or more cables have to go into the same duct they should always be drawn in together. Lead covered cables and those with no lead on the outside should never be pulled into the same duct. for if they bind anywhere the soft cable will suffer where two lead covered cables would get through all right. Some manufacturers are now putting on their cables a tape or braid covering, which saves the lead many bad bruises and cuts, and is a valuable addition to a cable at very little additional expense.

Practically all electric light and power cables are either single or double conductors, and the jointing of these is comparatively a simple matter, although requiring considerable care. The lead is cut back from each end about four or five inches, and the conductors bared of insulation for two or three inches. The bare conductors should be thoroughly tinned by dipping in the metal pot or pouring the melted solder over them. A sperm candle is better than resin or acid for any part of the operations where solder is used. A lead sleeve is here slipped back over the cable, out of the way, and the ends of the conductors brought together in a copper sleeve which is then sweated to a firm joint. This part must be as good a piece of work mechanically as electrically. The bare splice is then wrapped tightly with cotton or silk tape to a thickness slightly greater than that of the insulation of the cable, and is thoroughly saturated with the insulating compound until all moisture previously absorbed by the tape is driven off.

The lead sleeve is then brought over the splice and wiped to the cable. The joint is then filled with the insulating compound poured through holes in the top of the sleeve; these holes are then closed and the joint is complete, and there is no reason why, in light and power cables, that joint should not be as perfect as any other part of the cable. When the cable ends are prepared for jointing they should be hung up in such a position that they are in the same plane, both horizontal and vertically, and firmly secured there, so that when the lead sleeve is wiped on the conductor may be in its exact centre ; and great care must be taken not to move the cables again until the sleeve is filled and the insulation sufficiently cooled to hold the conductor in position.

It is also very important to see that there are no sharp points on the conductors themselves, on the copper sleeve, on the edges of the lead covering or on the lead sleeve. All these should be made perfectly smooth, for points facilitate disruptive discharges. Branch joints had better be made as T-joints rather than as Y-joints, for they are better electrically and mechanically, although they occupy more room in the manholes. They are of course made in the same way as straight joints, a lead T-sleeve being used, however. For multiple-arc circuits copper T-sleeves, and for series circuits copper L-sleeves, are used.

Telephone and telegraph cables are made of any required gauge of wire and with from 1 to 150 conductors in a cable. In jointing these the splices are never soldered, the conductors being joined either with a twist joint or with the so-called Western Union splice. Each splice is covered with a cotton or silk sleeve or a wrapping of tape, the latter

being preferable, although considerably increasing the time necessary for making the joint. Great care must be taken that no ends of wire are left sticking up, for they will surely work their way through the tape and grounds, and crosses will be the result. The wires should always be joined layer to layer and each splice very tightly taped in order to get as much insulating compound around each splice as possible in the limited space. The splices should be "broken" as much as possible, so as to avoid having adjoining splices coming over each other. After the joint has been saturated with insulating compound the wires should have an outside wrapping of tape to keep them in shape, and then the sleeve is wiped on and filled. If the insulation resistance of the jointed telegraph or telephone cable is a quarter of what the cable tested in the factory, it may be considered that an exceptionally good piece of work has been done. I have spoken more particularly of fibrous lead covered cables, as the handling of them includes practically every step of the work on any other kind of underground cable. In insulating dry core paper cables a paper sleeve is slipped over the splice, and in rubber cables the splice is wrapped with rubber tape; all other details are the same for these as for the fibrous cable.

In the laying of light and power cables every joint, as made, should be tested for insulation with a Thomson galvanometer, as the insulation must necessarily be very high, and if one joint or section of cable is any weaker than another it may be very important in the future to know it. All tests must be made after the joint has cooled, for while hot its insulation resistance will be very low.

Tests for copper resistance should also be made to determine if the splices are electrically perfect; an imperfect splice may cause considerable trouble. In telegraph and telephone cables the conductors should be of very soft copper, for in stripping the conductor of insulation it is very easy to nick the wire, and if of hard drawn copper open wires will be the result.

All work should be frequently tested for continuity with telephones, magnetos or small portable galvanometers. It is only necessary to ground the conductors at one end and try each wire at the other end. For this sort of work a telephone receiver used with one cell of some dry battery is most convenient, and has the additional advantage of affording a means of communication while testing, and is by far the best thing for identifying and tagging conductors.

These cables should be frequently tested during the progress of the work for grounds and crosses with a Thomson instrument, and when the cable is complete a careful series of tests of the capacity, insulation resistance and copper resistance of each wire should be made and the exact condition of the cable determined before it is put in service, and thereafter an intelligent oversight of the condition of the circuits can thus be more readily maintained.

Where a company has extensive underground service, a regular cable gang should be in its employ, for quick and safe handling of cables demands the employment of men accustomed to the work. If the cable has been properly laid and tests show it to be in good condition before current is turned on, almost the only trouble to be anticipated will be due to mechanical injury. Disruptive discharge, puncturing the lead, may occur; but the small chance of its occurring can be greatly lessened by the use of some kind of "cable protector," which will provide for the spark an artificial path of less resistance than the dielectric of the condenser, which the cable in fact becomes.

If a fault suddenly develops on a circuit, the chances are it will be found in a manhole, and an inspection of the cable in the manhole will generally reveal the trouble without resorting to locating with a Wheatstone bridge. The cable is often cut through at the edge of the duct, or damaged by something falling on it, or by some one "walking all over it." To guard against these, the ducts should always be fitted with protectors both above and below the cable. The cables should never be left across the manholes, for they then answer the purpose of a ladder, but should be bent around the walls of the hole and securely fastened with lead straps, that they may not be moved and the lead gradually worn through.

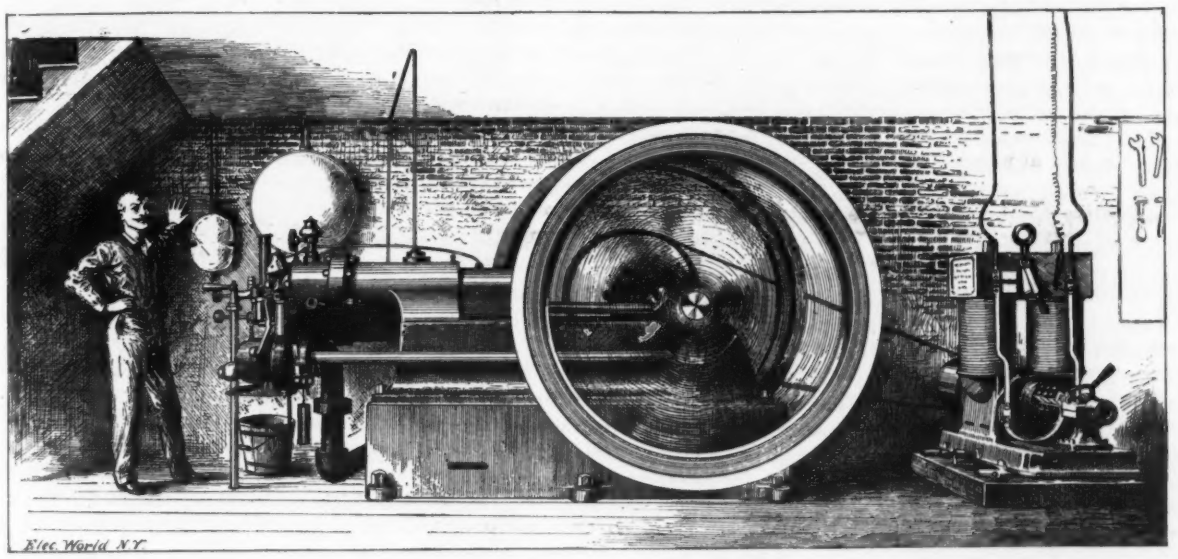
In telegraph cables, when one or two conductors "go," it will probably be useless to look for trouble except with instruments; but if several wires are "lost" at once it will probably be found to be caused by mechanical injury, which can be located by inspection. If it is ever necessary to loop out conductors, a joint can be readily opened and the conductors wanted picked out and connected into the branch cable and the joint again closed without disturbing the working wires. In doing this a split sleeve must be used, and the only additional precaution to be taken is in filling the sleeve to have the insulating compound not hot enough to melt the solder and open up the split in the sleeve. In cutting in service on light and power cables it is entirely practicable to do so without interruption of service on multiple-arc circuits, even those of very high voltage; but they require great precaution and involve considerable risk to the jointer, and where possible the circuit to which the connection is to be made should previously be cut dead. Where the voltage is not dangerous to human life, almost any service connection can be made without interruption of service.

I have only indicated a very few of the operations that may be found necessary, and the probable causes of troubles that may be encountered in the operating of underground circuits, believing that the different problems that arise can, with a little experience, be successfully met by any one who has a fair knowledge of the original construction of cable lines.

The Rollason Gas Engine.

The form of gas engine which we illustrate herewith is one that, although comparatively new to the American public, is somewhat well known under another name abroad, and has already achieved a high reputation for general effectiveness. It is the invention of Mr. Arthur Rollason, and has been manufactured for several years in England by the Beck Gas Engine Company. The Rollason company owns the patents for America, and its engines are built on the English specifications, embodying therefore all the useful features of a well tried machine. In general form the Rollason company's engine, as shown in the cut, doesn't differ widely from the ordinary forms of gas engine construction. It is an engine of the so-called three cycle type.

An explosion of mixed gas having taken place a piston is driven forward on its stroke; the exhaust valve is then open as it would be in a steam engine, and the returning piston expels through it a considerable portion of the products of combustion; during the next stroke the piston draws in and forces out a cleaning charge of air, expelling through the cylinder matter which might tend to clog it; on the third or some subsequent stroke, according to the load, another explosion ensues and the cycle is repeated. When the engine is running light half a dozen complete strokes or more may take place without explosion. Under load a fresh charge is ignited every third complete stroke. The connecting rod in the Rollason engine is pivoted direct to the piston, which has a guiding trunk, and the cylinder, as is usually the case, is water-jacketed. The piston chamber is surrounded with a ring of non-conducting material to free it from the influence of the jacket.



THE ROLLASON GAS ENGINE.

The working parts of the engine are driven by a shafting running parallel to the piston and engaging at one end with a crank shaft to which it is geared and by which it is revolved with a reduction of speed from three to one. The other extremity of the side shaft works the slide valve at the back of the cylinder and the gas-admitting mechanism, including the governor. As the governor balls rise they throttle the supply of gas to make it correspond to the load, and the lever, connected with the governor and carrying a weight, enables the speed of the engine readily to be varied. A sliding valve across the back of the cylinder admits the mixed gases to the piston chamber at the proper time. When the charge is to be admitted to the cylinder the valve ports allow both air and gas to flow in, following the motion of the piston, the first portion taken into the cylinder flows down its centre and dividing flows back along the walls. This portion being diluted with the air in the piston chamber locates itself near the firing port, while the portion of the charge more rich in explosive gas is nearer the piston. In practice the engine works very smoothly and regularly, and from every appearance is a well made piece of machinery. A year or two ago a 4 h. p. nominal engine of this type was put through a careful test by Prof. Kennedy, at a very heavy load, as high as an eight indicated horse power and 6.3 brake horse power; the gas consumption per indicated horse power per hour was only 21.68 cubic feet, while the mechanical efficiency of the engine was 87$\frac{5}{10}$ per cent. At more nearly nominal loads results even more satisfactory were obtained. Altogether the Rollason engine has shown itself already to be an efficient and reliable machine, and will be very sure to give a very good account of itself on its introduction in this country. The Rollason company intends to make some special efforts to introduce their engine as a prime mover for dynamos, as shown in our cut. A specimen plant is very shortly to be placed in position in the office of the company on Liberty street, and will there serve as an excellent example of the application of gas engines to electrical work, for which, where only small amounts of power are required, it is very well suited.

The Exhibition at Montreal.

In the last issue of THE ELECTRICAL WORLD illustrations were given of the exterior and interior of the Victoria Rink at Montreal, in which the Electrical Exhibition, to be given in connection with the meeting of the National Electric Light Association at Montreal, will be held. The floor plan of the rink was also given, together with an outline of the location and extent of the various exhibits, and the names of those who propose to contribute to the display. Some further information on this subject, received from the intending exhibitors themselves, will be of interest.

The Eureka Tempered Copper Company, of Northeast, Pa., will have an exhibit consisting of electrical outfits and samples of its tempered copper brushes and segments, and in fact a general display of the articles usually manufactured from brass and copper, all of which will be made from the Eureka tempered copper.

The Standard Paint Company, of New York City, will have a novel exhibit in the shape of two tables, the shape of which will be that of the letters "P" and "B," and these will be set side by side in the space allotted to this company. Between the tables the trademark of the company will be mounted on a pedestal, which will serve as a period to the letter "P." On these tables will be arranged various articles of the exhibit. In addition to this a miniature roof will be exhibited, and two walls fitted up with six wires and cross-arms will be painted with P. and B. paint to give some idea of the variety of applications of this material.

The Russell Arc Lamp Company, of Boston, will make an exhibit of the Russell arc lamp, showing the public an arc lamp which, with a single pair of carbons, will burn 12, 18 or 24 hours without attendance; besides the Baby Russell arc lamp, which is only 27 inches long from tip to tip, and 23 inches from the top of the hanger board to the bottom of the lamp, will be shown. The company expects to have several of its lamps in different sizes in operation at the exhibition, and will endeavor to substantiate its claim that the Russell lamp is the best distributor of light and the most economical arc lamp in the world.

The International Okonite Company's exhibit will very naturally be an elaborate one, and the display will not be very different from that which has been made by this company at former exhibitions, except that it will be on a larger scale. Those who are acquainted with the Okonite business may expect to see the familiar trademark of the company and a striking exhibit of its wires and cables occupying the company's space in the exhibition hall.

Chas. A. Schieren & Co., of New York City, will exhibit their patent perforated electric belts, both in rolls and running various dynamos and motors. They expect to have a very fine display, one which will be of interest to the public. Mr. G. H. Hamblett, manager of the company's Boston house, and Mr. Charles A. Schieren, Jr., will represent the company at Montreal.

The Ball Electric Light Company, of Toronto, which has been manufacturing the Ball system in Canada since 1882, has never made any exhibit outside of the Toronto Industrial Exhibition, but it has secured space and will make quite a display at the Victoria Rink next week. The company will exhibit its double armature arc light dynamos and especially the 4-ampère machine, together with single and double arc lamps and the Bernstein incandescent lamps burning on a 4-ampère arc light circuit. A display will also be made of incandescent dynamos and motors, the Wenstrom electric power generators and Wenstrom motors, for which the Ball company is the Canadian agent, and possibly a line of general electric supplies and fittings. This company will at the same time make an exhibit at the Industrial Exhibition at Toronto, which is open from the 9th to the 18th of September, where it will light all the principal buildings with 150 arc lamps of the Ball system, as it has done for the past six years. The company extends a cordial invitation to those attending the Electric Light Convention to visit Toronto at the close of the Montreal meeting and attend the Industrial Exhibition.

The Toronto Construction and Electrical Supply Company, of Toronto, Canada, has secured about 400 square feet

of space in the exhibition hall, and proposes to exhibit a complete line of electrical supplies of all kinds, including the following specialties: Grimshaw wires and tape, Ward arc lamps, the Vulca system of interior conduit, Partrick & Carter's annunciators and bell goods, Samson batteries, etc. This company has a branch warehouse in Winnipeg for the convenience of the Western trade, and in St. John, N. B., for the East. The older provinces are managed directly from the head office by means of traveling salesmen, who cover the country thoroughly four or five times a year.

The Dominion Wire Manufacturing Company, Limited, of Montreal, proposes to exhibit pure copper wire of the different sizes from 0000 down to number 30, manufactured from pure Lake Superior bars; also galvanized and telephone wire, iron and steel wire of different sizes, both tinned, plain, and galvanized, besides wood screws, wire nails, wire rope, etc.

The Electric Engineering and Supply Company, of Syracuse, N. Y., will send to Montreal a neat exhibition board and frame in cherry, with oak panels, on which will be arranged the different products of its factory. Among these will be large station switches on marble and steel bases, porcelain bases, branch switches, porcelain branch main cut-outs, porcelain key and keyless rosettes, and sockets for Edison, Thomson-Houston and Westinghouse systems. Another feature of this company's exhibit will be the Packard lamp, for which it has recently become the general Eastern agent. An exhibit will also be made of the Jenney electric motor and dynamo, using a 10-h. p. motor to drive an incandescent dynamo which will light the lamps on the exhibition board mentioned above. As this company is the general agent for the Jenney Electric Motor Company in Canada, its exhibit will be peculiarly appropriate. Messrs. Pass and Seymour will occupy a portion of the space allotted to this company with an exhibit of their porcelain specialties, such as are used in the manufacture of the Electrical Engineering and Supply Company's goods.

The Eugene F. Phillips Electrical Works, Limited, of Montreal, proposes to make the largest display of its line of goods that has ever been attempted, and as this concern is the largest in Canada of underground and aerial cables and insulated electric wires of every description, a very elaborate description may be expected.

The Standard Underground Cable Company, of Pittsburgh, Pa., will have the company's initials made of brass letters, holding samples of cable, and mounted on a handsome hard wood base as a part of its exhibit. Handsomely mounted samples will be shown of Duplex No. 3 cable, 100,000 feet of which is in use in the city of New York alone; the No. 6 single cable, 50,000 feet of which is in use in New York City by the United Electric Light and Power Company; No. 4 single cable, of which 1,750,000 feet is in use in the cities of Philadelphia, New York and Washington, and a specimen of the company's cable having cross section of 500,000 circular mils. In addition to these specimens, there will be a sample board containing every style and size of cable which is to be used in filling the company's contract with the Minnesota Brush Company, of Minneapolis, which was recently secured, and the installation of which will cost the company $100,000 and will require 400,000 feet of cable. A large quantity of small samples of various kinds and sizes of electric light cable and insulated wires will be taken to the exhibition for the purpose of distribution. The literary part of the exhibition will not be forgotten, and the company will have on hand a great variety of circulars and catalogues for distribution to the public.

The Standard Electric Time Company, of New Haven, Conn., will occupy a wall space of 8x10 feet. The company has been granted privilege to distribute its clocks throughout the exhibition building, and three large dials will be placed on the gallery in the main hall. An exhibit will also be made of the company's self-winding clocks and regulators, secondary dials and electric gauges. It is thought that the convention will appreciate the advantage of having electric time in the different departments. Mr. Geo. W. Hutchinson, the secretary and treasurer of the company, will have charge of the exhibit, and will probably be on hand during the week of the convention.

The Johns-Pratt Company, of Hartford, Conn., doesn't intend to make a very elaborate exhibit, but will be on hand with a few samples of its large molded insulators of which it is now making a specialty. The company will be represented there by its secretary, Mr. E. B. Hatch, and by Mr. T. S. Cheney.

The Thomson-Houston International Electric Company, of Boston, has secured for its exhibit in the rink 3,500 square feet of floor space, in which it proposes to place electrical apparatus of various sorts; but, in addition to the space in the rink, the company occupies as much space as is necessary in the McGill University Laboratory, where it has placed two 50 h. p. 500 volt dynamos operated by a McIntosh & Seymour engine. These two dynamos furnish their current to the rink through wire manufactured by the Simplex Electric Company, especially placed for this purpose. At the rink there are electric motors wound for 500 volts of four sizes, viz., 75, 45, 15 and 10 h. p., all supplied with a complete complement of measuring apparatus and protective devices placed upon a proper switchboard. These motors in turn drive the dynamos for incandescent and arc lighting and one specially designed machine for supplying current to a Van Depoele reciprocating rock drill, which is to be shown in the company's exhibit in operation. The alternating current system of this company will be represented by a 650 light machine operated by the largest of the electric motors. This will feed a number of lamps from transformers and will operate a system of incandescent lamps connected in series on what is known as the "Street Incandescent System." This dynamo will also furnish current for two 2,000 candle power alternating current arc lamps with their special transformers. The 45-h. p. motor will drive an Excelsior arc-light dynamo, which will be connected to a full complement of arc lamps and one 10-h. p. motor also supplied by the Excelsior Company, of which the Thomson-Houston International Electric Company is the Canadian agent. A direct current 110 volt dynamo is operated by another motor and serves to light the exhibition hall. A number of transformers of various sizes will be shown in pyramidal form in a prominent part of the exhibition. Their secondaries are connected to the bank of 600 16-candle power incandescent lamps so arranged as to be either suddenly connected or disconnected from circuit. These show the perfect regulation of the Thomson-Houston dynamo. A Goulds triplex pump having cylinders 5 × 8 inches is driven by direct current from a 5-h. p. electric motor, with special waterproof construction. An electrical hoist of 15 h. p. capacity will also be shown in actual operation. A Robinson radial car truck, equipped with two 15-h. p. single reduction gear motors, will show one of the latest developments of electric street railway apparatus. A number of Thomson recording wattmeters will be placed in various parts of the exhibition. The electric rock drill mentioned above will be mounted upon a tripod, and will be shown in the practical operation of boring in granite. In addition to this extensive exhibit Thomson-Houston measuring and protective devices, including switches, cut-outs, lightning arresters, etc., will be shown, mounted upon a suitable switchboard.

The Canadian Electrical Construction Manufacturing and Supply Company, of Montreal, will exhibit a kiosk made of wire and cable, furnished by the Simplex Electrical Company, of Boston, for which this company is the Canadian agent. Besides this, large coils of wire will be piled up around the kiosk, which will be lighted with incandescent lights and arranged inside as a parlor. A display will also be made of 300 Economic incandescent lamps, of a sample board of the Bryant switches, and sockets, of Perkins switches, samples of Economic lamps, and Speedwire stretchers manufactured by L. E. Wilcox & Co.

The Jewell Belting company, of Hartford, Conn., will exhibit two very neat and useful souvenirs for distribution at Montreal. One of these is a red leather purse for holding banknotes and stamped with the company's name, while the other is a match case made of the same material and similarly stamped.

Messrs. Thompson and Robertson will exhibit the fibrous dry battery and porous cups in operation on open circuit work, such as bells, annunciators, etc. Mr. Louis Walsh will be on hand to represent the company.

Besides those mentioned above and in the list which we published last week, applications for space have been made by the Norwich Insulated Wire Company, of 50 Cedar street, New York City; by the Excelsior Electric Company, of Boston; the Hart and Hegeman Manufacturing Company, of Hartford, Conn.; the Connecticut Motor Company, of Plantsville, Conn.; John Fitzgerald, of Montreal; The E. S. Greeley & Co., of New York City; the Delaware Hard Fibre Company, of Wilmington, Del.; the Phœnix Glass Company, of 729 Broadway, New York City, and by the Germania Electric Company, of Boston, Mass. More than 50 applications for space have been confirmed, and without doubt a very large number of applications will yet be made. No such opportunity has ever occurred as the coming exhibition will be for the firms of the United States to place their goods before the Canadian public, and, judging from what has already been done by the 50 firms named in our columns, this fact has been very fully appreciated by the various companies.

Although Mr. Gulick, the chairman of the Committee on Exhibits, is new in the electrical field, his work has been very effective in that position. The general plans and the financial arrangements were formulated by him and the secretary of the association, Mr. Beane, and the foresight displayed and businesslike methods pursued are now evident as the details of these plans are being carried out in Montreal. A very large share of the credit is due to Mr. Gulick for the smooth working of the arrangements of the exhibition.

Cost of Electric Traction.

The figures giving the cost of operation of the electric cars on the West End Street Railway in Boston, for the month of July, have just been compiled by the auditor and are here published in full. The figures for April, May and June were given in THE ELECTRICAL WORLD of July 25 and Aug. 1, 1891.

The report for July shows a decrease of $7,965 in net earnings as against June, but an increase of $88,359 over April, and $38,770 over May. June is the banner month in the street railways of Boston, and it is expected that net earnings will gradually decrease from June figures until such time at least as the increase of electric lines brings about a decrease in operating expenses. Operating expenses for July are 63.15 per cent. for the system as it stands today, and while this is in contrast with 61.37 per cent. for June, the company can pay 10 per cent. upon its present common stock with operating expenses at 70 per cent.

The real point of West End earnings, says the Boston *News Bureau*, is to be found in the electric lines expense account. As the new power houses of the West End came into operation the result is seen in the reduced cost of motive power. In April and May the motive power for a horse car cost 10.86 cents per mile, while in June and July it could not be got lower than 10.38 cents. The motive power for an electric car has now been got down to seven cents per car mile, and will be lower in future.

	Total.	Electric.	Horse.
Gross receipts	$554,431	$144,552	$409,878
General expenses	27,613	6,955	20,657
Track and car expenses	179,853	43,891	135,954
Motive power	142,670	26,398	116,271
Total operating expenses	350,137	77,249	272,888
Net earnings	204,294	67,303	136,990
Miles run	1,497,568	377,191	1,120,377
Ratio mileage	100.	25.19	74.81
Per cent. operating expenses	63.15	53.44	66.58
Earnings per mile run	37.02	38.32	36.58
Expenses per mile run:			
Motive power	09.53	07.00	10.38
Car repairs	00.75	01.17	00.61
Damages	00.07	00.12	00.06
Conductors and drivers	07.91	06.92	08.23
Other expenses	05.12	05.37	05.07
Total expenses per mile run	23.38	20.48	24.35
Net earnings per mile run	13.64	17.84	12.23

In connection with these reports of the cost of electric traction on the Boston road, the following interview with Mr. Thos. Lowry, president of the St. Paul and Minneapolis street railways, will be of interest. Mr. Lowry's lines have lately exchanged their horse for electric equipment. What he says of the cost of operating electric cars is of especial interest. He says: "I suppose it is a fact that we have at St. Paul and Minneapolis the biggest electric system in the world, and moreover everybody is perfectly satisfied with its operation. We hear nothing but praise. Here are to-day nearly 350,000 people, and not a horse car in either city. Minneapolis has 120 miles of street railway all equipped with the overhead electric system, with posts set in the middle of the street and arms for the wires extending over the track on either side. St. Paul has 90 miles of street railway; 75 miles of it are in the electric system and 15 miles in cable, but we shall take up part of the cable road and supplant it with electricity, except where we have to mount a 17 per cent. grade. Here we must keep the cable in. One can now travel by our electric line from the north side of Minneapolis to St. Paul parks, over 20 miles, upon a transfer check. This, I think, is farther than from the back side of East Boston to West Roxbury. I have just received from the West the first monthly report of the Minneapolis street railway system, in which no horse account appears. It shows gross earnings for July of $107,571 and expenses of $52,585 and net earnings of $54,985. This shows expenses of less than 49 per cent. for operating and I feel perfectly sure that within two years we shall be operating our entire electric system of 215 miles in two cities for less than 40 per cent. for expenses. A year ago our Minneapolis lines were earning about $70,000 a month. We have increased our gross earnings 50 per cent. by the improved facilities which the electric lines afford to the traveling public. I have looked over the June monthly statement of the West End Street Railway, and I believe that, with the volume of traffic here in Boston, it will operate with a good deal less than 50 per cent. for expenses when you have gotten your horse cars from between your electric cars. With the horse cars out of the way you can run nearly one-third more trips with the same equipment. We use principally Lima oil for fuel, which costs us $1 a barrel, most of it for transportation from Ohio. I think it takes about three barrels to make the equivalent of a ton of coal; but, at any rate, I figure that it costs us only $1 a day for power to run an electric car, where we are operating 150 cars in the system. Horses used to cost us $3.85 to $4 a day per car with our low priced grain. I think it must cost the West End $5 per day for horses per horse car. You see that here is a great saving, and then there is the increased number of trips and the increase in the number of passengers carried, as the facilities are increased. All the people in the Northwest are enthusiastically in favor of the electric system. We have had every kind of power, and find in the winter the overhead electric is better to work through snow drifts than either steam, horse or cables, and we have tried them all. We have used electricity now for two years, and we think we know something about motor repairs and the general repair account, and we expect this account to diminish instead of increase. The principal item is the burning out of the armatures, but this becomes less as employés become more experienced, and operations become systematized. The ratio of operating expenses on electric systems is downward, not upward. My report of this morning from Minneapolis covers 11 electric lines for July. The line of our heaviest traffic, 9½ miles, between Minneapolis and St. Paul, shows only 35 per cent. of a 5-cent fare as cost of operating. We run trains of two cars on this line, and we are going to run three cars as the traffic increases. The principal increase in expense will be the cost of a conductor, as we have a man on each car. I don't see why Boston expenses for the electric system cannot be got down to between 35 and 40 per cent. with its immense traffic.

Transportation to the Montreal Convention.

The Committee on Transportation has found that, owing to the inability of the West Shore Railroad Company to make suitable connections on the return trip as was at first arranged, making a change of trains necessary, it is advisable to change the route. Instead of leaving New York as previously announced in a circular sent out by the committee, a special train will leave the Grand Central station, at 42d street, at 9:10 A. M. Sunday, Sept. 6, arriving in Montreal at about 9:35 P. M. The following rates have been secured: Fare from New York, round trip, to Montreal, $12; fare from New York, round trip, to Montreal (certificate plan), $13.33; fare from New York to Montreal, one way, $10; extra, each way, for parlor car accommodations, $2.

Delegates from the South and West desiring to take this train should purchase through tickets *via* New York Central and Hudson River Railroad, and Central Vermont Railroad. For the convenience of the New York delegates railroad tickets and information can be obtained at the Electric Club, 17 East 22d street, New York City, on Saturday, September 5, from 3 to 8 P. M. The excursion tickets will be good to return until Sept. 20. Railroad tickets and parlor car accommodations can be secured at the office of the New York Central and Hudson River Railroad Company, 413 Broadway, New York City. Further information can be obtained by addressing the secretary of the association.

Street Railway Convention at Pittsburgh.

Owing to the electrical nature of their annual meetings, the gatherings of the street railway men are of especial interest to electric light and power men, who will be interested to know that the tenth annual convention of the American Street Railway Association will be held in the Monongahela House, Pittsburgh, on Oct. 21, 22 and 23 next. This association is the only national organization of street railway men now in existence in this country. It was organized in Boston in 1881, and now has the names of 171 street railway companies on its roll of members. At the coming Pittsburgh convention it is expected that fully 300 delegates will be in attendance, in addition to about 300 manufacturers of street railway supplies. The membership is limited to the officers, individual owners and lessees of street railways, the manufacturers of street railway supplies not being permitted to take part in the proceedings, unless by special invitation. The object of the American Street Railway Association, as set forth in its constitution, is "the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways and the diffusion of this knowledge among the members of this association, with the view of increasing the accommodation of passengers, improving the service and reducing its cost; the establishment and maintenance of a spirit of fraternity among the members of the association by social intercourse, and the encouragement of cordial and friendly relations between the roads and the public." The officers of the association for the present year are as follows:

President, Henry M. Watson, of Buffalo, the president of the Buffalo Railway Company; first vice-president, William A. Smith, general manager of the Omaha Street Railway Company; second vice-president, Charles Odell, president of the Newburyport and Amesbury Street Railway Company, of Newburyport, Mass.; secretary and treasurer, William J. Richardson, secretary of the Atlantic Avenue Railway Company, of Brooklyn, N. Y. Executive Committee: Thomas Lowry, of Minneapolis; David F. Henry, of Pittsburgh; Albert E. Thornton, of Atlanta; Henry M. Littell, of Cincinnati, and Thomas C. Keefer, of Ottawa, Canada.

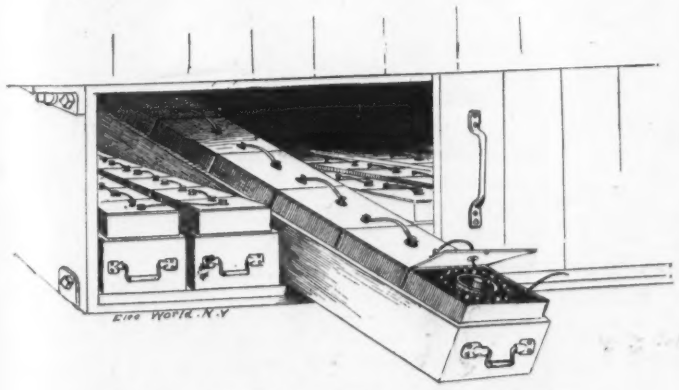


FIG. 2.—ARRANGEMENT OF BATTERIES.

During the convention in Pittsburgh the association will hold four business sessions, the remainder of the time to be devoted to sightseeing. Among the papers to be read are the following:

"A Perfect Electric Motor," by H. A. Everett, secretary of the East Cleveland Railroad Company, Cleveland, O.

"A Year's Progress of Cable Motive Power," by J. C. Robinson, formerly vice-president of the Los Angeles Cable Company, Los Angeles, Cal.

"Public and State Treatment of Corporations," by G. Hilton Scribner, president Central Park, North and East River Railroad Company, New York.

"The Dependent Overhead or Underground System of Electric Motor Power," by George W. Mansfield, of the Attleboro, North Attleboro and Wrentham Street Railway Company, of Attleboro, Mass.

"The Independent Storage or Primary Battery System," by Knight Neftel, electrician Lancaster Street Railway Company, Lancaster, Pa.

In addition to the above papers the convention will discuss the relative merits of cable and electric power in street railroading, expedients for reducing operating expenses and increasing traffic, the construction of power houses and the safeguards against fire, breakdowns and other accidents, the prospects and possibilities of the storage battery and conduit electric cable, the use of street cars as collectors and carriers of the mails, labor troubles and other matters pertaining to and having a bearing on the various systems of street railways.

The Duggan Bracket and Railway Chair.

The Burnham and Duggan Railway Appliance Company, 70 Kilby street, Boston, holds the patents on and is manufacturing a very neat adjustable trolley wire bracket, as shown by the cut herewith.

As will be seen this bracket may be readily adjusted to the supporting pole whether the pole be straight or crooked. This one item will recommend it, especially where perfectly straight poles are hard to secure and very expensive.

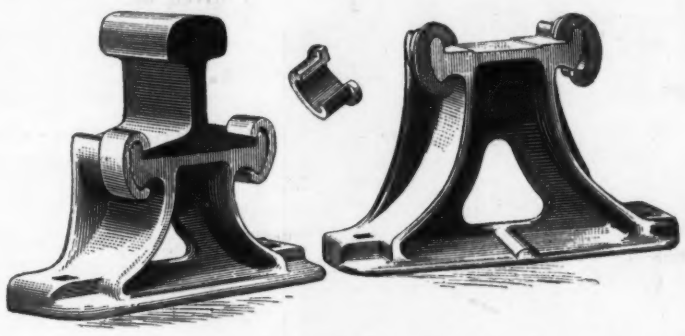


FIG. 1.—DUGGAN'S RAIL CHAIR.

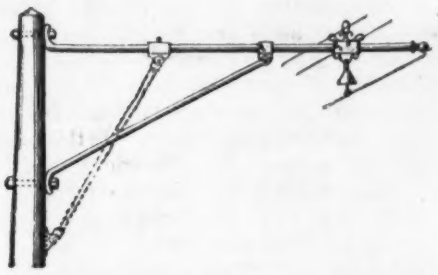


FIG. 2.—DUGGAN'S RAILWAY BRACKET.

The railway chair, as will be noticed by the illustration, is very simple, easily put in place, and inexpensive as regards first cost and in the matter of repairs. There are no bolts, rivets or wedges used. Paving blocks may be laid close to the rail, and the rail may be removed at any time without drawing the spikes or changing the position of the chair.

Several thousand of these chairs are in use, giving the best of satisfaction. One of the latest contracts of this company was the equipping the Worcester, Leicester & Spencer Electric Railway, twelve miles in length.

A Railroad Car Lighted by Primary Batteries.

It is not a common thing to see a railroad car lighted by electricity, although a number of these are in regular service in this country, but it is still more uncommon to find a car carrying a complete outfit of primary batteries from which it is lighted throughout. It is a fact, however, that three cars on the New York & New England Railroad are fitted out in this way by the Safety Electric Lighting Company, of Boston. Two of these are the regular coaches, and the third is the directors' private car, the coaches being lighted by 10 or 12 incandescent lamps of 16 c. p. each,

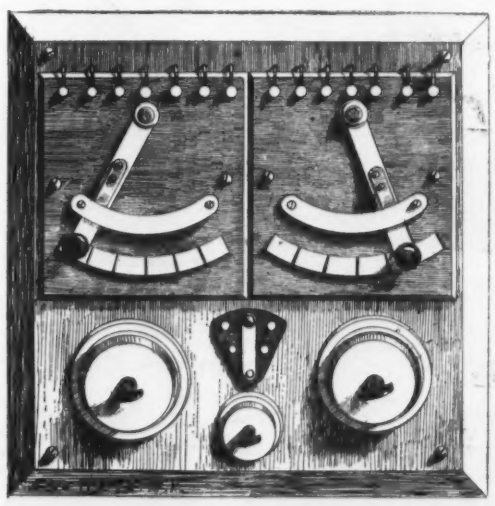


FIG. 1.—SWITCHBOARD OF CAR.

while the directors' car, owing to its numerous apartments, requires 22 lights of 16 c. p. each.

Last week the private car made a trip to New York City over the New York & New England road and was sidetracked for a day in the Grand Central station in this city. Although there is nothing strikingly new about the plan of lighting railway or other cars by primary batteries, the novelty of this particular installation and the rarity of plants of this kind in actual service make it of considerable interest.

The car carries an equipment for a long run of 120 primary cells, just double the number required on an ordinary coach. In this case each set of 60 cells supplies half the lights in the car, the two circuits being entirely independent. The lamps are of 16 c. p. each and require 106 volts at their terminals to bring them to this candle power. One set of the lamps is controlled by the switch at the lower right hand side of the switchboard shown in Fig. 1, which is placed in a convenient location, and the other set is controlled by the corresponding switch at the lower left hand corner of the board. The 60 cells are of course placed in series, several circuits, however, being led out from intermediate points of the series through the upper part of the switchboard in such a way that any specified number of batteries, say 20, 30, or 40, may be cut out of the circuit if desired. This, of course, cuts down the E. M. F., and, consequently, the candle power of the lights in circuit. This is done for the two circuits by the switches shown at the top of Fig. 1. The lamps may thus be burned at any brilliancy from a dull red to full candle power. The lamps are tastefully arranged about the car, and each one is furnished with a reflector.

The cells are placed beneath the car in a compartment just large enough to contain the 60 cells, each of which measures 6 × 6 × 8 inches. Fig. 2 shows how the cells are arranged for removal from their place when it is necessary to change the liquid. They are placed in 10 trays, each of which holds 6 cells.

As will be seen from the illustration, the cell is a zinc-carbon one, the zinc of which weighs two and a half pounds and the carbon being arranged in several small rods about the porous cup. It is claimed that 35 hours continuous lighting can be obtained from the cells before a change of the liquid becomes necessary. Mr. C. A. Cotton is the electrician of the company, which is about to establish a factory for the manufacture of these batteries for use in railroad lighting.

Electricity at the World's Fair.

As part solution of the difficulties under which the Department of Electricity of the World's Fair has labored in the organization of its work, the Board of Control of the World's Columbian Commission passed, on Aug. 17, the following resolution:

Whereas, It has been represented to this board, by the Directory of the World's Columbian Exposition, that a very large saving may be effected in that branch of the work of construction which relates to the supply and distribution of the adequate power, light and heat essentially necessary for the suitable equipment of the buildings to be devoted to exposition purposes, provided the owners of boilers, engines and machinery, or other appliances which may be secured for that exclusive purpose by the said Directory of the World's Columbian Exposition, shall not be, on account of the primary devotion thereof to such utilitarian purpose, precluded from entering such boilers, engines, machinery and other appliances as competitive exhibits within the several classes to which they shall respectively properly belong; and this board has been requested to take appropriate action in this behalf; and,

Whereas, This board recognizes that the duty and responsibility of the work of construction and furnishing suitable buildings, adequately equipped for exposition purposes, rests exclusively upon said World's Columbian Exposition, subject—when completed and tendered—to the right of acceptance by the National Commission; and this board is, therefore, unwilling to assume responsibility in any degree in such work of construction, or to authorize any department or agency subject to its authority to do so; therefore,

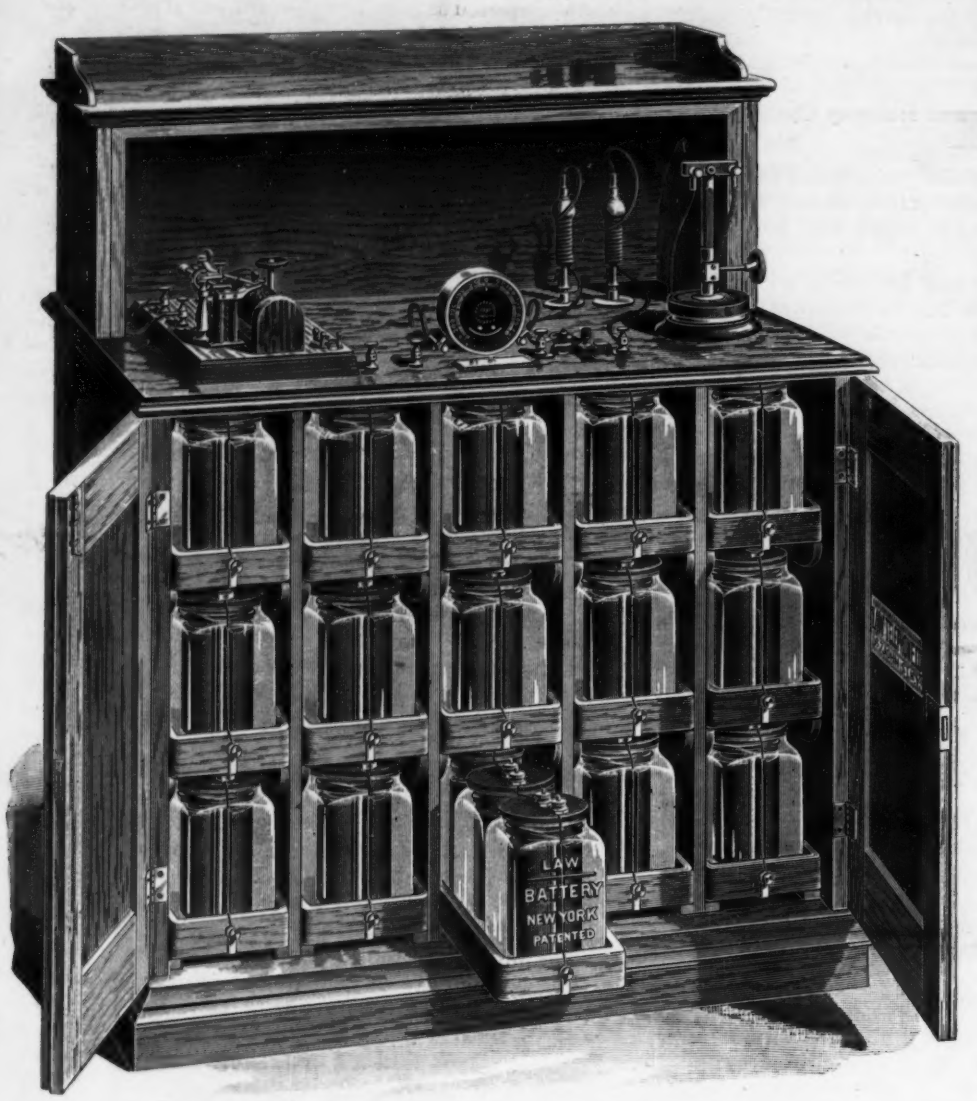
Resolved, That it is the judgment and opinion of this board, and it hereby—in so far as it may lawfully do so—declares that the fact that such boilers, engines, or other machinery or appliances as shall be procured and located by the Directory of the World's Columbian Exposition, and be by them devoted to the supply and distribution of adequate power, light and heat for the exposition buildings, shall not preclude the entry of the same, by the owners thereof, as competitive exhibits in the classes to which they may severally belong; subject, however, as to the classification and installation thereof, to the rules and regulations prescribed by authority of the National Commission.

On Wednesday of this week the Executive Committee of the Local Board of Directors of the Exposition passed unanimously the following resolution:

"The Grounds and Buildings Committee to instruct the Chief of Construction to first obtain the concurrence in writing of the Committee on Electricity, etc., of plans, plants, estimates and proposed contracts for electrical plants and appliances before submitting the same to the Grounds and Buildings Committee for action."

This action on the part of the two bodies controlling the

coming exposition is regarded as a thoroughly sufficient guide in the conduct of the work of the electrical department and no further trouble is anticipated. As will readily be seen from the first resolution, the electrical department is relieved from all responsibility in the matter of installation for the service of the exposition, but it is left absolutely with department chiefs to control all installation where



AN ELECTRO THERAPEUTICAL OUTFIT.

that installation has to do with their exhibits. In other words, the chief of construction of the local board is made entirely responsible for all construction for the service for the exposition. In the resolution adopted by the executive committee leaving all matters pertaining to the electrical work for the exposition to the disposal of the Committee on Electricity, it will readily be seen that the position of the latter is materially strengthened. The electrical committee is composed of some very bright men, two of whom, at least—Col. Clowry, of the Western Union; Mr. B. E. Sunny, of the Thomson-Houston Company—being expert electricians. This committee has been and is thoroughly in sympathy with Prof. Barrett, and has agreed with him from the organization of the department up to the present time upon all matters passed upon.

The work of the department will be begun actively and vigorously at once along the lines laid down. A circular will be prepared within the next few days setting forth the scheme of the department, and following that a pamphlet will be issued containing all the information that prospective exhibitors will want. A separate pamphlet will be issued for foreign prospective exhibitors, and an early attempt will be made to enlist the co-operation of the foreign electrical people.

An address will be read before the Montreal Convention by some one delegated by the department, in which it is proposed to set out the plans in full for the benefit of the electrical people of this country.

The department is now busily engaged upon plans for furnishing light and power to the electrical building.

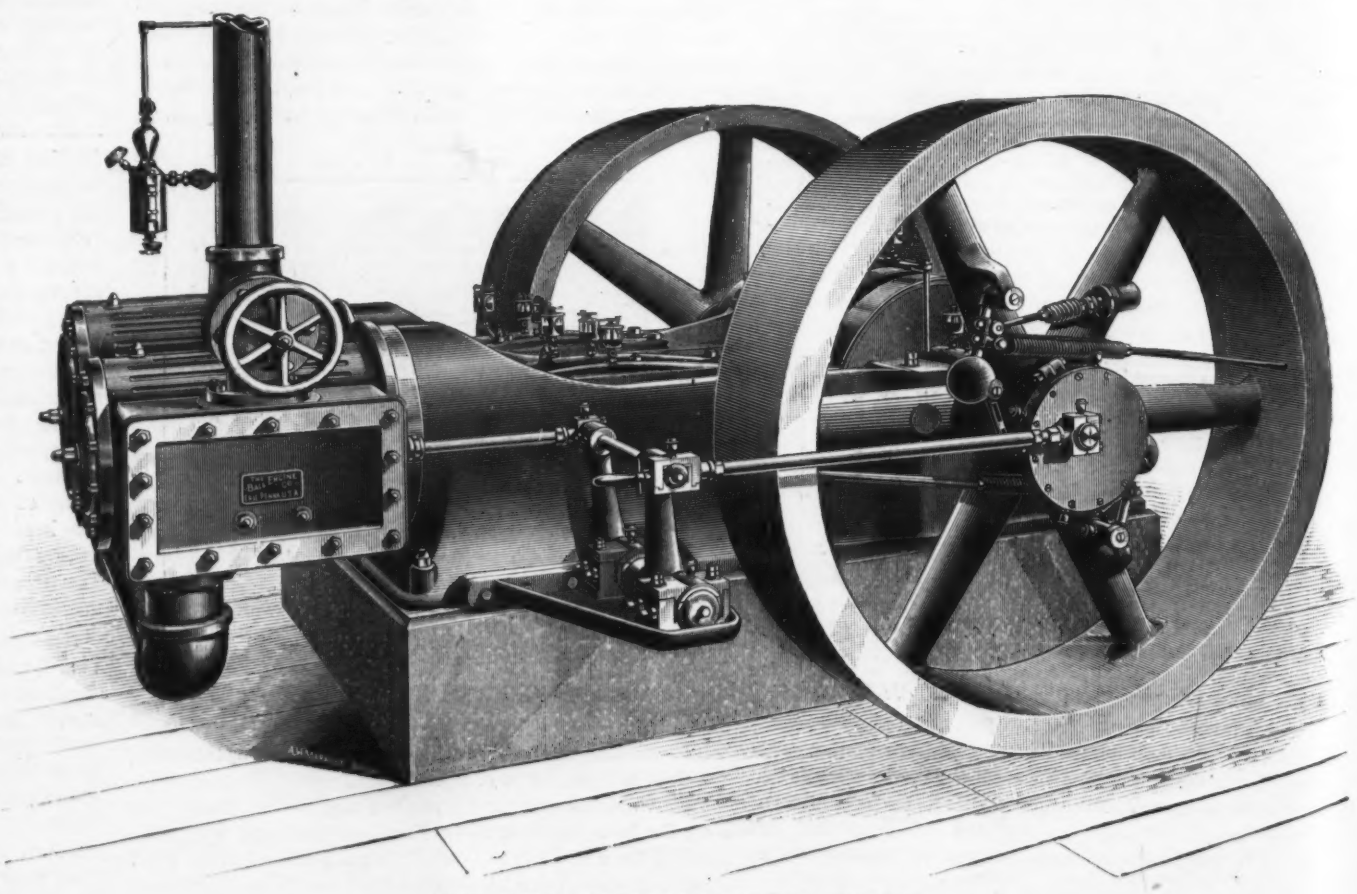
An Electro Therapeutical Outfit.

The medical use of electricity has gradually worked its way into respectability until now an electrical equipment of some kind is to be found in a large proportion of doctors' offices. A very complete sample of the outfits arranged for physicians' use is that illustrated herewith. It includes a medical induction coil, milliampère meter, pole changer, current regulator, and a battery of about 50 Law cells finely arranged in trays. The whole is inclosed in a very neat roll-top cabinet, making a rather elegant addition to the furniture of a physician's office, and at the same time containing everything in the electrical line that he is likely to need for office work, aside from electro-cautery. The current regulator has been described before in our columns, and is in a very fine form, consisting of carbon plates which can be gradually lowered in the water by means of a rapid pinion, thus throwing a variable resistance into the circuit. The Faradic coil is fitted with both an ordinary rapid make and break device found on nearly all inductorials, and also with a slow interrupter, which gives a steady series of shocks at brief intervals depending upon the adjustment of the apparatus. The intensity of these can be readily varied by the adjustment of the coil itself. Altogether the complete equipment is one that will commend itself to physicians as containing the necessary apparatus in a convenient and available form.

The Ball Engine Company's Cross Compound Engine.

Two years ago the Ball Engine Company, Erie, Pa., brought out the first engines of this type for the new electric lighting station of the Edison Electric Illuminating Company, of Brooklyn. It was decided to build these engines in the form of a double or cross compound, as it was believed that a higher rotative speed could be successfully used when the work was distributed over two sets of crank pins and journals, rather than with the use of a single set of bearings of larger size, as in the case of a tandem compound engine developing the combined power of the double compound. The engine was especially designed for heavy work, and all the parts were made unusually large and massive.

The crank shaft is made of the best open-hearth steel, with the cranks opposite each other, one counteracting the



THE BALL CROSS COMPOUND ENGINE.

effect of the other, so that the engine is perfectly balanced and capable of being run at a high speed with quietness and ease and without heating. All the parts of the engine are of first-class materials, and are finished with the greatest care.

The valve provides for quick admission of steam, and insures against all possible leakage. The pistons are as readily accessible as in a single cylinder engine. The improved governor gives better regulation than is possible with any other form of governor. Instead of using the eccentric and strap on the low pressure side, as is commonly done, an adjustable wrist pin plate is bolted directly to the hub of a wheel. On this plate is the valve driving crank pin. This is a late improvement of the Ball Engine Company, Erie, Pa., and it is found much preferable to the eccentric and strap, as on account of the smaller area of the crank pin there is but little wear and little oil required. This arrangement is shown in the back view of the engine. The valve operating mechanism is the simplest and most reliable arrangement possible.

The Ball Engine Company builds a special cross compound engine for street railway work, and has a number of engines in successful operation in this work. Among the large street railway generating stations using this engine are the Rochester Street Railway, Rochester, N. Y., and the Buffalo Street Railway, Buffalo, N. Y. The results attained both in economy and its performance under very trying conditions have been entirely satisfactory.

The desire of large central station and other practice for an economical and reliable engine of medium power and occupying a comparatively small space has been met by the cross compound engine manufactured by the Ball company. Under the conditions of variable load generally encountered in service, the makers claim that the cross compound will give more satisfactory results and produce power at less cost than any type of slow speed Corliss engine, and considerable less than any single cylinder high speed engine. No power is absorbed in driving shafting and pulleys, the engine can be operated at its most economical cut-off, and the governor gives closer regulation under changes of speed and boiler pressure than is possible with a slow speed engine.

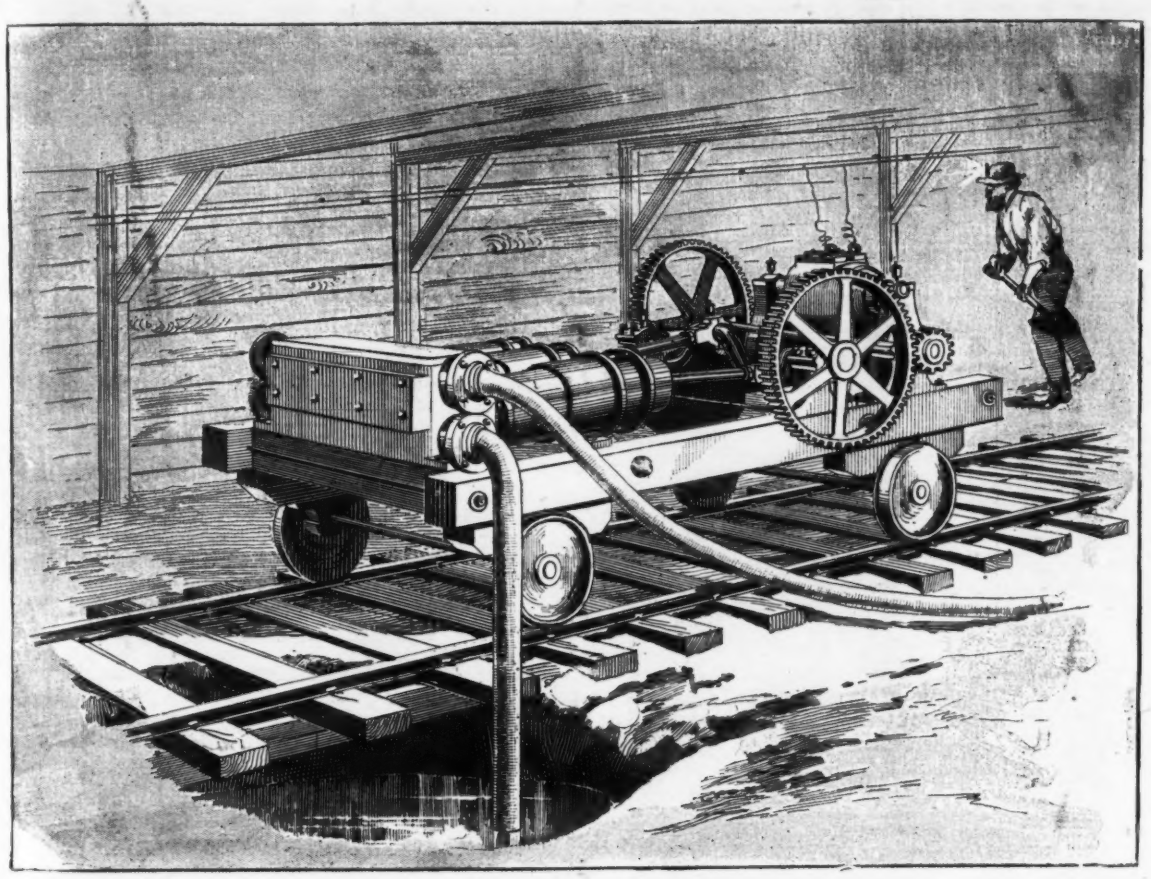
As regards the economy of this engine it will be of interest to notice its performance in the plant of the Edison Electric Illuminating Company, of Brooklyn, N. Y., as this company has erected and put in operation an electric lighting station which in all its appointments ranks with the most advanced works of the kind in existence. The steam plant includes a perfect system for obtaining as well as for watching and recording results, the consumption of coal is brought down to a low figure, and perfected apparatus is provided for ascertaining exactly what coal is burned. Thus a statement as to the pounds of coal consumed per electrical and mechanical horse power is entitled to the fullest confidence, being based on accurate weighing of every pound of coal consumed and of every pound of ashes left.

The station is situated at 358-362 Pearl street, Brooklyn. It is 75 feet front and 100 feet deep. At present it contains fourteen No. 72 dynamos driven by four 300 and three 250-h. p. Ball compound engines made by the Ball Engine Company.

The 250-h. p. engines have one 12-inch and one 22-inch cylinder, with 16-inch stroke. The 300-h. p. engines have one 13-inch and one 25-inch cylinder, with 16-inch stroke. They run at a rate of about 220 revolutions per minute. The steam is supplied by eight Babcock & Wilcox tubular boilers. The following is the general system of operating the steam plant.

The coal is received and weighed, and is elevated to the floor above the boilers. Thence it is distributed to the chutes, which in the illustration are seen leading down in front of each boiler. The chutes are provided with valves at the bottom, and are carried by scale levers, and connected with a scale beam. The chute is filled with coal.

the bottom valve being shut. It is then weighed. The weight of the chute is allowed for, so that one weighing gives directly the weight of coal. The valve is then opened, and the coal falls down upon the floor, and is used as required for the boilers. When more coal is needed, a chute full is again weighed and delivered. The ashes as removed from the ash pan are carefully preserved and weighed before being sent away. This keeps an actual watch upon the quality of the coal, and gives the basis for actual efficiency per pound of real combustible matter consumed. The consumption of coal is 2.75 pounds per indicated horse power and 3 pounds per electrical horse power.



THE GOULDS PORTABLE MINING PUMP.

A Portable Mining Pump.

One of the many foes the miner is often obliged to encounter is a sudden in-rush of water, so rapid as to cause serious inconvenience, if not danger. Bailing is sometimes well nigh impossible, and a pump is needed right there and immediately. To meet this demand as effectively as may be the Goulds Manufacturing Company, of Seneca Falls, N. Y., has very recently brought out a new and powerful modification of its well known triplex electric pump, intended to meet the special demand of mine work. It is well shown in our cut, and consists, as will be readily seen, of an electric motor geared to a triplex pump and mounted on a little tram car that can be readily moved about on the ordinary mine tramways. The necessity for such a piece of apparatus is almost self-evident, but if examples were needed plenty could be furnished from the experience of the Goulds Manufacturing Company in its dealings with its customers. One excellent example was met last year in the experience of the Pancoast Coal Company. A "dip" in the mine was struck, and the outflow of water was more than 20 men could bail, so in desperation the company was about to put in a steam pipe when an electric pump was thought of, and in 30 hours was put in position and cleared the place of water. The dip was more than 3,500 feet from the shaft, and the expense of placing and running the pump for four months proved to be less than the cost of steam pipe to the head of the shaft. The work in this case was done by an ordinary Goulds triplex pump and a Thomson-Houston motor, but without the convenience of portability of the new horizontal pump, the use of which would have considerably accelerated the work. At present these horizontal pumps are made in but two sizes, with pump cylinders respectively 4 × 6 and 5 × 8 inches; the latter size, which has proved more generally useful, is fitted, like most of the other Goulds pumps, with a Thomson-Houston motor, in this case of 5 h. p., and has a capacity of from 60 to 80 gallons per minute. Altogether this latest addition to the long list of Gould pumps already manufactured is one that commends itself to the miner at first sight, and would doubtless give a good account of itself in every-day use.

The New Short Railway Generator.

It is an event well worthy of notice when one of the great electric railway manufacturing companies puts upon the market an entirely new generator. This is particularly true when to genuine novelty in design is added principles of construction which are so evidently well adapted to their purpose that the advance upon existing methods is at once evident, even to the uninitiated.

The Short Electric Railway Company has just brought out the first of a series of railway dynamos which are admirable in every respect. They are massive in form, beautifully simple in construction, and are marked with the mechanical perfection and finish for which the Short company has always been noted.

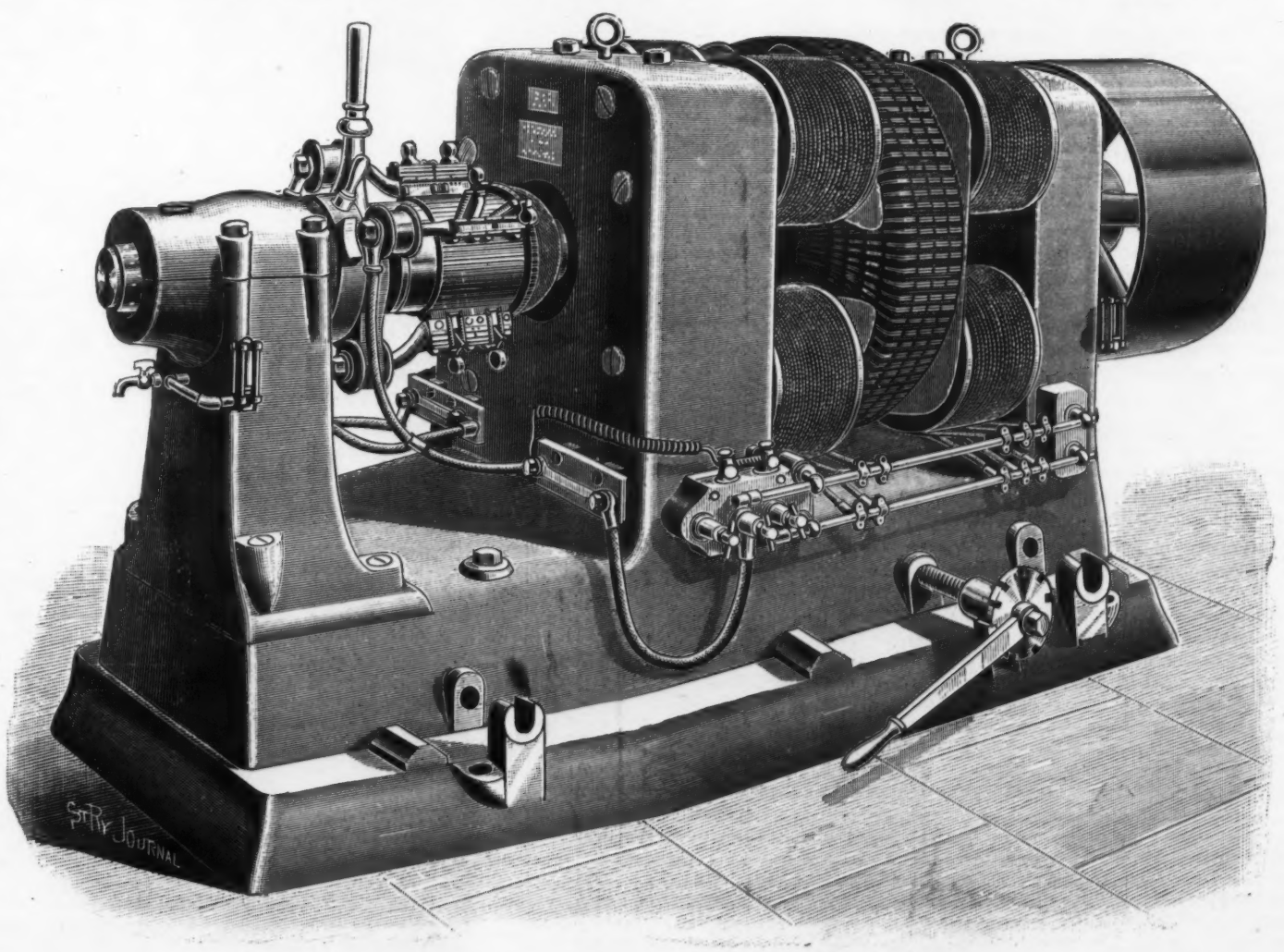
The illustrations gave an excellent idea of the 150-h. p. generator, capable of delivering in continuous service 225 ampères at a pressure of 500 volts, equivalent to a total electrical output of 112,500 watts, and having in fact a reserve capacity above the normal of at least 30 per cent. in both current and voltage.

The great field magnet frame is one of the largest and most perfect single castings ever made for electric work. It weighs over 800 pounds, and nothing but the softest and purest iron is used in the melting pots. It is annealed very slowly in the molds, and when finished is so soft that it can easily be indented with a hammer. For properly finishing up the casting it is necessary to build a monster planing machine—one of the largest to be obtained.

To this heavy frame are bolted eight field magnets carrying the shunt and series coils and provided with pole pieces of peculiar shape, arranged for side presentation to the armature and so dispersed as to make a powerful and almost perfectly uniform "field of force" with a narrow "magnetic gap" of large diameter.

Within this space revolves the armature, which is a distinctive feature of the machine. Its peculiar construction is well known to all who are familiar with the past practice of the Short Company, which was the earliest, and for a long while the only, prominent advocate of what is known as the "Gramme ring" construction for railway motors and dynamos, but which has lived to see the value of this method of construction conceded by all street railway men and by nearly every manufacturer of electric railway apparatus.

Upon a shaft nine feet long by six inches in diameter is keyed a massive spider carrying the foundation ring upon which the armature is built up. The armature core is formed of this sheet iron wound spirally on the foundation ring and riveted firmly together. The outside circumference of the ring is somewhat wider than the remainder, and this portion is milled out into notches forming a modified Pacinotti ring. The coils are then wound on the core around the hollow ring, the method being such that each and every one of the 200 coils is entirely exposed to the air on all sides, thus securing the perfect ventilation which is obtainable in no other type of armature. The projecting coils are in fact a sort of fan, and in standing before the machine the current of air set in motion by the armature can be detected 10 or 15 feet away. As a consequence both armature and field run cool, and it is almost impossible to burn out a coil even with heavy overloads. Moreover, the destruction of a single coil does not affect adjacent coils, and it is even possible in case of necessity to run the machinery for several days without rewinding a burned out coil—a feat absolutely impossible with any type of Siemens armature. A burned out coil can be wound by any good mechanic at a cost of two or three dollars and a half day's labor. One of the most noteworthy features of the armature is its large diameter, viz., 36 inches, which is also, by the way, the diameter of the pulley usually employed with high speed engines. In seeing this magnificent generator in operation, one is struck with its analogy to the Corliss engine, the large armature and pulley revolving at slow speed seeming like the great flywheel of a Corliss, in comparison with which the long narrow drum armature of other dynamos is analogous to the high speed type of engine. The centre of gravity is low and the machine runs smoothly and quietly.



THE NEW SHORT ELECTRIC RAILWAY GENERATOR.

The details of construction are carefully worked out. The armature shaft runs in large self-centering and self-oiling bearings, the lubrication being accomplished by rings carried by the shaft and drawing oil from a reservoir in the usual way. The height of the oil is indicated by the little sight glass on each box. At the commutator box is also found an adjustable ball bearing thrust collar containing

several hundred balls, and so arranged as to carry the armature thrust in either direction without the slightest heating. This is an entirely novel feature in this class of machinery.

The commutator is carefully built and unusually large in diameter, viz., 20 inches. It has 200 bars, so that the pressure between two adjacent bars is very small, and the sparking nil. The brushes are four in number, and are carried by two independent collars and sets of brush holders. In order to secure perfect adjustment at the neutral points, multiple carbon brushes are used. The terminals of the field coils are carried to two heavy bars, held securely in place on each side of the base of the machine. The plan of connections is simple and in plain sight, and the machines are so exactly duplicates of each other that there is no necessity for complicated "shunt spools," or other adjusting devices, beyond the ordinary field rheostat box.

The dynamo is placed on a heavy foundation plate, and moves on V-shaped rails by means of an ordinary ratchet bar and screw. The electrical properties of the machine are quite as noteworthy as the mechanical. The magnets always work far below the saturation point, even at heavy overloads. The compounding has been so carefully calculated that the "pressure curve" is a straight line, passing from 500 volts at no load to 525 volts at full load, with speed maintained constant at 500 revolutions.

The Short company is building this type of generator in five sizes, viz., 75 h. p., 100 h. p., 150 h. p., 300 h. p., and 500 h. p. The last named size will run at about 100 revolutions and will be connected direct to a vertical compound engine, thus doing away with all belts and shafting.

Cope's Wire Tightener.

It is probable that even larger sizes will be built later on to accommodate the heavy railway work which is immediately in prospect.

The Short company is to be congratulated upon the bold and advanced steps which it is taking in street railway work.

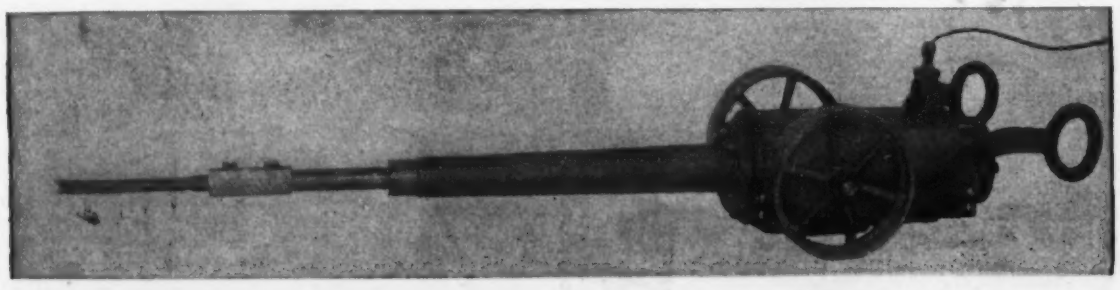
Being in a position to devote its entire attention to railway apparatus, it has exceptional opportunities and every inducement for perfecting each detail, and its friends look with the utmost confidence for a brilliant and successful career, built on a foundation of thoroughly reliable apparatus and a reputation for enlightened management and honorable dealing second to no company in the field.

Cope's Wire Grip for Linemen.

The accompanying illustration of an automatic "come along," or wire grip for linemen handling light or heavy cables, invented by Mr. T. J. Cope, No. 8 North Sixth street, Philadelphia, deserves notice not only on its merits as a grip, but because of its simplicity. It consists of two jaws, slightly corrugated on the inner side, and working loosely in two stationary supporting jaws in such a manner that when the wire or cable is placed between the loose parallel jaws and drawn, the jaws are closed from mere contact to sufficient pressure to hold the cable or wire. It will be seen that there is no more pressure on the insulation or wire than is necessary to hold the same, and the direct pull and long jaws prevent twist or kink in the wire or breaking of the insulation. The wire is easily released by merely reversing the pressure on the tool.

A Solenoid Coal Cutter.

In some grades of coal it is found desirable to make the under cut with a machine concentrating its power upon a single reciprocating shaft, carrying a chisel at its extremity. This type of cutter or drill is very compact and is controlled by one man, the direction of the blow being varied as occasion demands. Several machines of this type, operated by steam or compressed air, are on the market, and while in many ways satisfactory, the application of electricity as the motive power possesses many decided advantages.



SOLENOID COAL CUTTER.

The illustration shows the Van Depoele solenoid coal cutter, manufactured by the Thomson-Van Depoele Electric Mining Company, of Boston. The type shown is the present standard form, though modifications can be made to suit special requirements. The operation of the cutter may be easily understood from an inspection of the illustration and no extended explanation is required. The direction of the blow is determined by the operator, who sits in the floor facing the breast, his feet resting against the wheels, and his hands grasping the handles at the rear of the cylinder, thus obtaining a double leverage, by which the machine, being almost balanced, is easily turned on its points of support.

A simple switching device turns the current on or off, as desired, while lights, pumping apparatus, electric ventilators, etc., may be run on the same system of wires which supply power to the coal cutter, if desired.

The weight of the apparatus is a little over 700 pounds, the number of strokes usually from 300 to 350 per minute, although the rapidity of the blow can be varied at pleasure. The stroke is from five to six and one half inches. The tension guide can be furnished in different lengths, according to the depth of under cut desired.

The Adams Rotary Engine.

The novel features of the improvement in rotary engines, shown in the illustrations here presented, will attract special attention from the large class of our readers who are interested in the uses and possibilities of steam power. As will be seen in the drawings the piston head is secured upon the shaft within the cylindrical casing and fits closely against the inner faces of the removable cylinder heads, and its lower side is contiguous to the inner face of the casing.

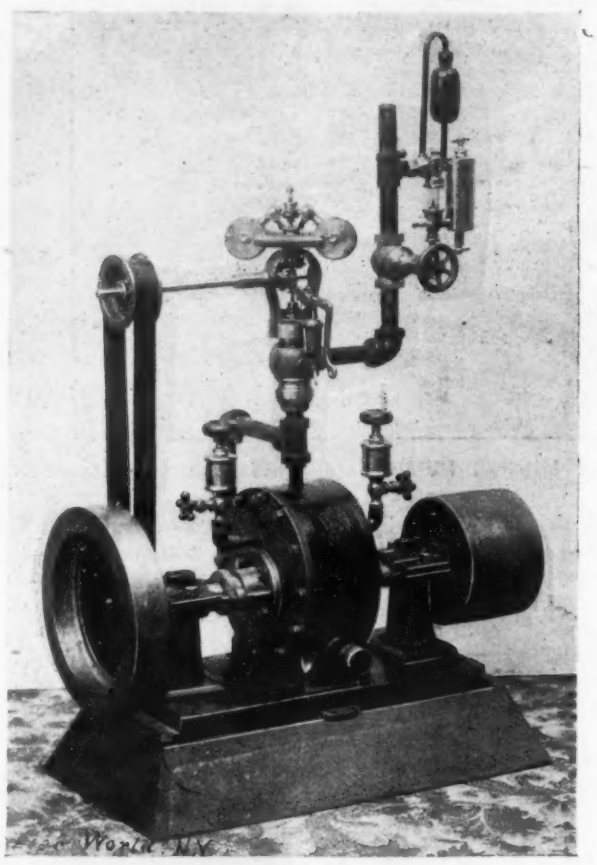


Fig. 1.—Adams' Rotary Engine.

In this head seats are cut upon a radial line, which closely receive the pistons, which are equidistant from each other. The outer edges of these pistons bear against the inner wall or face of the casing, and their inner ends bear upon, and are held in contact with, the casing by means of a ring. This ring may be a strip of spring sheet metal loosely and helically wound so that its tendency is to uncoil and thus expand, or a split steel ring inserted between the pistons and then permitted to expand against them, so that it bears with a spring tension against them at all times, supporting the pistons and holding them in close contact with the casing. There is such a ring at each end of the pistons. These rings are not secured to the heads of the casing nor to anything, but simply lie against the heads and are gripped between the pistons. The outermost end of the strip of spring metal is scarfed off, so that when wound the outer face of the ring will form substantially a circle and be free from any jog or shoulder to prevent the free rotating travel of the rings within the pistons.

Two of the pistons are constructed with an opening or port through them leaving a rim across and constituting the outer edge of the piston. As the steam enters the casing through the inlet pipe it exerts its force against the piston, causing the head to rotate, and when the piston on the right has been carried to substantially the position here shown, then the port therein opens and the steam passes through it into the chamber in front of it and expansively exerts its force upon the upper piston. Thus the port pistons alternately take steam and open as described, so that the steam operates expansively and there are only two exhausts through the exhaust pipe although there are four pistons. Furthermore, these pistons are so disposed that they balance the spring ring between them; also, the pistons are free to rock upon the rings.

The inventor of this engine, Mr. W. G. Adams, of Weedsport, N. Y., claims that it is capable of high speed and has the advantage of great economy in steam and fuel. It is certainly simple in construction, with few parts to get out of repair and it is evident that it operates with little friction.

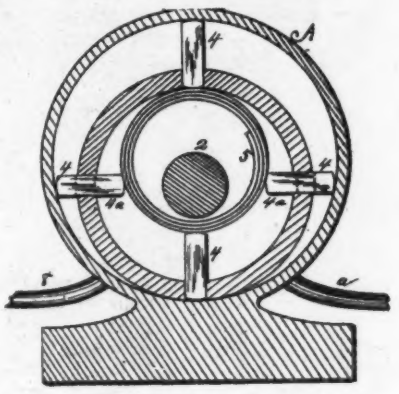


Fig. 2.—Adams' Rotary Engine.

These engines have been in practical use for various purposes during the past six months, and Mr. Adams states that they have fully demonstrated by their work all that he claims for them.

A number of them are being built for marine purposes, for which they are peculiarly adapted, being light, compact and requiring no elaborate foundation.

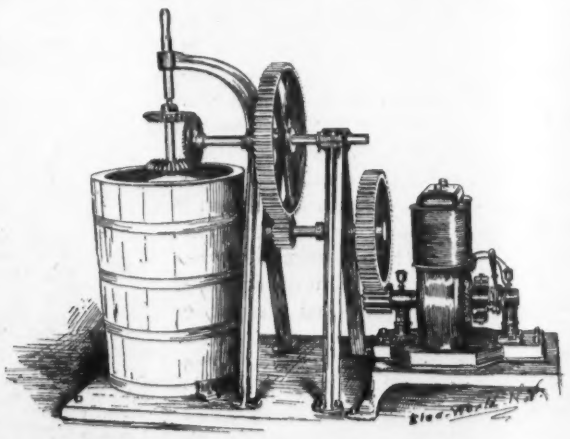
Carbon Resistances.

Mr. J. Munro, writing to the London *Electrical Review* upon this subject, which has been pretty thoroughly discussed in the columns of that paper, has contributed the following note on the earliest use of carbon as a resistant. The quotation which Mr. Munro contributes is taken from "A Treatise on Atmospherical Electricity," by John Murray, published in London in 1830. The quotation referred to reads as follows:

"Mr. Howldy, of Hereford, an ingenious electrician, has by some novel experiments clearly proved the increased power of electricity if retarded in its progress; instead of using tubes of glass filled with water, as Mr. Woodward had done, he has employed a glass tube supplied with lamp black."

Electric Motors for Driving Light Machinery.

At the present time there are scores of industries in which the electric motor is utilized for driving light machinery where not over 1 h. p. is needed, and very often not more than ¼ h. p. An illustration of this is shown in the accompanying cut, which represents a combined electric motor and ice cream machine, manufactured by I. F. Betts, 511 Orange street, Wilmington, Del. The motor is wound for the incandescent circuit with a fibre pinion on the motor-shaft to reduce the speed of the ice cream machine to 80 revolutions per minute. The machine is fitted with cut gears, runs smoothly and quietly, and is giving excellent satisfaction. Different speeds of the machine may be secured by the use of a resistance-box which is arranged to be placed in circuit.



MOTOR DRIVING AN ICE CREAM MACHINE.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

TELEPHONE STOCKS.

Chicago	$230@	$240	Cumberland	$60@	$62
Central Union	52@	53	Wisconsin	118@	120
Michigan	83@	84	Bell of Missouri	160@	165
Great Southern	30@	32	Iowa Union	20@	22
Colorado	34@	36	Missouri and Kansas	54@	56
Rocky Mountain Bell.	40@	43			

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95@	$100	Chicago Edison Co	$145@	$150

NEW INCORPORATIONS.

The Roland Avenue Electric Railway Company has been organized at Baltimore, Md., with a capital stock of $25,000, to operate a passenger railway outside of Baltimore. A. C. Rutherford, C. O. D. Lee and Douglass Thomas are interested.

The Wright & Starr Electric Company, of Philadelphia, Pa., has been incorporated with a capital stock of $250,000, for the purpose of manufacturing and dealing in electrical appliances. Among the promoters are Benjamin F. Morley, of Chester, Pa., and E. E. Wright, of Philadelphia.

The Bradshaw Lumber Company has been incorporated at Suffolk, Va., with a capital stock of $50,000, for the purpose, among other things, of establishing gas and electric light works. The incorporators are W. H. Bradshaw, W. H. Jones, Jr., C. W. Jenkins, J. L. Gray and E. E. Holland.

The Cœur d'Alene City (Idaho) Illuminating Company has been incorporated with a capital stock of $20,000, for the purpose of carrying on an electric lighting business in Kootenai county, Idaho. The promoters are M. R. Kellinger, Chas. D. Barry, B. Mahlum, and W. L. Gleason, of Portland, Ore.

The East Side Land Company, of Goshen, Va., has been incorporated, with a capital stock of $25,000, to purchase real estate, mine and quarry, build and lay out streets, gas, electric and water works, railways, etc. J. R. Jones, C. W. Jones, A. D. Smith, Jr., A. Alexander, and T. A. Browning, Jr., are its incorporators.

The Red Oak Electric Company, of Red Oak, Ia., with a capital stock of $20,000, has been organized to construct, operate and maintain the necessary structures, fixtures and apparatus to supply electricity for light and other uses. W. H. Blood, of Kansas City, Mo., and A. Miller and F. H. Hutchinson, of Red Oak, Ia., are the organizers.

The People's Electric Street Railway has been organized at Beaver, Pa., with a capital stock of $50,000, for the purpose of constructing and operating a street railroad from Bridgewater to Economy township, Beaver county, Pa. Among those interested are Dan H. Stone, Jas. P. Stone, of Beaver Falls, Pa., and Hartford P. Brown, of Rochester, Pa.

The West and South Town's Horse Railway Company, of Chicago, Ill., has been incorporated with a capital stock of $100,000 for the construction of horse, electric, cable and dummy railroads on Twenty-second street from Lawndale to Lake Michigan, and on other streets. The promoters are C. L. Bonney, L. C. Bonney and M. A. Bonney, all of Chicago.

AFFAIRS OF THE COMPANIES.

Bell Telephone Output.—The following table gives the output of telephones for the month ending Aug. 20, and also for the period from Dec. 21:

Month Ending Aug. 20:

	1891.	1890.	Inc.	Dec.
Gross output	5,773	4,322	1,451	.....
Returned	4,309	2,761	1,548	.....
Net	1,464	1,561	.....	97

From Dec. 21 to Aug. 20:

	1890-91.	1889-90.	Inc.	Dec.
Gross	48,396	42,686	5,710	....
Returned	27,708	17,752	9,956	.
Net	20,688	24,934	.....	4,246

Thomson-Houston Company's Business.—It is reported that the sales of the company the past week aggregated $500,000. The directors of the West End Street Railway Company have authorized a contract with the Thomson-Houston company for new motors aggregating $500,000. One of the largest single sales of electric lighting apparatus ever made by the Thomson-Houston company was effected last week, consisting of 4,000 incandescent and 600 arc lights. The business of the arc light department of the Thomson-Houston company, which was the only department operated by it for many years, is showing a constant increase in volume, the sales for the present year being considerably in excess of the corresponding period for 1890.

Westinghouse Company's Meeting.—The adjourned annual meeting of the Westinghouse Electric and Manufacturing Company was set for Aug. 26, at Pittsburgh, and a few stockholders were present, but no formal proceedings took place, there being no business to transact. The object in naming a day for a further meeting was that in case anything should come up in connection with the reorganization plan which would require the attention of the stockholders, such matters could be brought forward at the meeting. An official of the company remarked on the 26th inst.: "There is no use in adjourning from time to time. The work of reorganizing is going along smoothly and as rapidly as circumstances will permit. The directors can do and are doing all that is necessary to complete the plan, and there is nothing for the stockholders to do." It is now the expectation that the new certificates of stock will be ready for issue not later than the 15th of September.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Aug. 31, 1891.

Colonel Thomas Lowry, of "Minne-Paul," Minn., is stopping at the Fifth Avenue this week.

Mr. J. J. Nate, purchasing agent of the Chicago Telephone Company, was in New York City last week.

The Bishop Gutta Percha Company, New York, gave its employés an enjoyable outing on Saturday of last week.

The Edison Illuminating Company, of Brooklyn, N. Y., is installing a Smith & Vaille boiler feed pump in its station.

Mr. W. S. Elliot, the electric railway tourist of the Chicago office of the Edison General Electric Company, was a visitor in New York last week.

Mr. C. P. Rutty, of the McCreary Electrical Specialty Company, leaves this week on a trip to the West and Northwest with a number of new specialties.

A Remarkably Large Switch.—Mr C. S. Van Nuis, 136 Liberty street, New York, has built some Ajax switches having a carrying capacity of over 1,500 ampères (about 1,100 h. p.) for central station electric railway work.

Mr. H. Ward Leonard, who so narrowly escaped fatal injuries through a runaway accident, being thrown from the high seat of his cart, is able with the aid of a strong pair of crutches to be at his office and to attend to business.

The International Okonite Company, 13 Park row, New York, has issued price list No. 5 of okonite insulated wires and cables, that contains, in addition to the usual price lists, much information convenient to have at hand.

Lieut. Ernest Hoefer, the general manager of the Illinois Electrical Material Company, of Chicago, and Mr. H. S. Winston, the President of the company, dined at the New York Electric Club this week as the guests of Mr. Henry Reed of the Bishop Gutta Percha Company.

Mr. E. L. Babcock, president of the Falls Rivet and Machine Company, Cuyahoga Falls, O., was quartered at the Fifth Avenue Hotel in New York last week, while en route to Providence, R. I., where he is installing a set of clutch pulleys in the Narragansett Electric Lighting Company's station.

Consumers' Purchasing Agency.—Mr. W. S. Chesley, Electrical Exchange Building, New York, is in receipt of many orders from central station managers and others who appreciate the opportunity thus afforded of quickly securing just the article desired, and also of securing goods in quantity at lowest market prices.

Electric Lights on Staten Island.—Owing to the destruction by fire of the electric light plant at St. George three weeks ago, the territory covered by the Electric Light Company's lines has since been without light. On the 22d the temporary works on the old site were started up and a current supplied to the lights for the first time since the fire.

Frisbie Elevators.—One of the new Frisbie electric elevators is doing excellent work at 762 Broadway. By the way, the D. Frisbie company is so rushed with orders on clutches, elevators, etc., that it is obliged to run night and day. The company will shortly increase its facilities by building an additional factory as large as the present one and by increasing its capital $100,000.

Truex & Vail, of 136 Liberty street, New York City, received a large order from the Pittsburgh Gas Light and Coke Company (of Pittsburgh, Kan.) on the 24th inst., for their swinging ball lightning arrester. They were informed by the Pittsburgh company that it had suffered to the extent of five hundred dollars during the month of July from lightning, and that it has now decided to equip the plant with their lightning protector.

Messrs. Thomas H. Dallett & Co., mechanical and electrical engineers, of Philadelphia, have opened a New York office at 126 Liberty street, which will be under the efficient management of Mr. N. L. Schloss. As is well known, this company handles the Billberg electric motors and generators, and a general line of machine tools, besides being the agent of the Triumph compound engine. Mr. Schloss will introduce the Billberg motor in New York City, and push energetically the business of his company.

The Brooklyn Electric Light and Power Company held a special meeting last week to take action on the dissolution of the company. The resolution for dissolution was offered and passed by the board of trustees last February. Many of the stockholders objected to the course taken by the board. The company has been unable to get any privileges from the authorities of the City of Brooklyn. Mr. Cocheu offered a resolution that the trustees rescind their action for dissolution. This was lost by a vote of 953 to 1,224. He then offered a resolution asking that five trustees, who have accepted office in the rival company, be asked to resign; but this resolution was also lost.

The McCreary Electrical Specialty Company, of 136 Liberty street, New York City, is just completing a handsome new catalogue, which will show many new novelties. This company is a very prosperous one. Its standard reflectors and shades are now in use in some of the largest churches throughout the United States, and are well known in most of the foreign countries. The United States Treasury Department has just contracted for 64 12-inch reflectors, and is placing them in the new annex. At the office of the McCreary company a dark room has been fitted up, where its various appliances are shown under the influence of the electric light. These are worth going many miles to see.

Meeting of the New York Railway Men.—The ninth regular annual meeting of the Street Railway Association of the State of New York will be held at the Hotel Metropole, Broadway and Forty-second street, New York City, on Tuesday, Sept. 15, 1891, at 10:30 A. M. A special committee has been appointed to present a report at this meeting on the subject of "Electric Motive Power for Street Surface Railways," electricity being the leading topic of interest in the street railway community. It is expected that the discussion following the report will develop the very latest information obtainable on the subject. Entertainment will be provided for the delegates, and the secretary urges every company in the State to be represented.

The Fibrone Manufacturing Company, which made an assignment some few days since, has been reorganized and is now known as "The Fibrone Company." Under the new régime the company is prepared to do a larger business than ever, as in addition to the old factory the company is about to lease or build an additional one. Mr. John B. Campbell, formerly secretary of the Fibrone Manufacturing Company, and Mr. Howard C. Whitney, well known to the electrical trade through his connection with the Crosby Electric Company and the Consolidated Electric Storage Company, will be general sales agents of the company, under the firm name of Campbell & Whitney, and will occupy offices at 258 Broadway, where the great variety of novelties manufactured by them can be seen.

L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Aug. 29, 1891.

Claflin & Kimball, agents for the well known Perkins lamps, report business exceedingly brisk for this season of the year.

The Somerville (Mass.) Electric Light Company has just installed a 250-h. p. McIntosh & Seymour tandem engine through J. A. Grant.

H. D. Winston, president and treasurer, and Ernest Hoefer, vice-president and general manager of the Illinois Electric Material Company, Chicago, were in Boston on a business trip the first of the week.

Milford, Conn.—It is reported that a company is being formed here for the purpose of building an electric street car under the Stevens and Usher patents, and if the matter goes through it will undoubtedly prove a good thing for the town.

The Circleville Light and Power Company has been organized at Circleville, O., with a capital stock of $100,000, for the production of electricity. The promoters are Chas. J. Delaplane, Howard Jones, N. E. Jones, Fannie M. Moore and J. L. Stribling.

Samuel Hale, agent and treasurer of the Portsmouth company, has leased the plant of the South Berwick and Salmon Falls Electric Company, and will hereafter operate it. The company is lighting the streets of Salmon Falls and South Berwick, and has a large amount of commercial business in both of the above towns.

It is said that the largest electric locomotive ever constructed is the one now in use by the Lonsdale Cotton Mills Company, at its factory at Lonsdale, R. I. The locomotive can haul 30 tons; length of track in use, 2,700 feet. The trolley system is used, and power is supplied by a Thomson-Houston company 500-volt dynamo operated by a water wheel.

Stockbridge, Mass.—Engineers Hull and Palmer, of Bridgeport, Conn., are drawing up the plans for building a dam on the Housatonic River at Stockbridge for the Monument Mills; power is to be furnished in this way for running a 600 electric light plant from which the Monument Mills will be lighted and the illumination furnished for the city of Stockbridge. This is the first definite move to utilize the water power of the Housatonic.

Lawrence, Mass.—The board of fire engineers at the recent meeting voted that all applicants for the position of electrician for the fire alarm system should be given an examination by an electrical expert, and that only those passing the examination successfully be considered eligible candidates for the position. Superintendent George W. Adams, of the Atlantic corporation, was agreed upon as the electrical expert.

H. E. Swift & Co. have consolidated with the Pettingell-Andrews Company, the well known supply house. The former company will, however, retain its independent corporate name and management. The officers of the company will be: H. E. Swift, president; F. E. Pettingell, vice-president; D. A. Andrews, Jr., secretary and treasurer. A new factory of brick, four stories 40 × 80 feet, will be erected at once at Jamaica Plain, where ample facilities will be had for the manufacture of the various well known specialties of both companies.

The Abington and Rockland Electric Light and Power Company is making good progress with its new station, which is being built of brick of the best possible design for the convenience of the business. A steam plant has been ordered, including boilers adapted for high pressure. One engine is of 100 h. p. and one of 250 h. p., the latter of the McIntosh & Seymour tandem compound type. The selection of the site for the buildings was made with particular reference to the facilities offered for using the condensing system and for securing the coal supply.

The Woonsocket (R. I.) Electric Machine and Power Co.'s report shows that the company is in excellent condition financially, having a surplus on hand July 1 of $27,429 as compared with $16,199 on July 1 of the previous year. Meanwhile the company's quarterly dividends have been paid, at the rate of 5 per cent. annually, and one at the rate of 6 per cent. The construction expenses of the company, owing to the extension of the service of some 20 miles of line, have been considerably increased, and it is a fact that much of what is ordinarily charged to construction is by this company charged to maintenance. The company is now putting in a 750-h. p. cross compound Corliss engine of the latest pattern, which, combined with its water power and steam power, will give a total of about 1,400 available horse power.

C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, CHICAGO, Aug. 29, 1891.

The Santley Lumber Company, Wellington, O., has just received an order for 15 large belt holders from a prominent electric light company.

Mr. Frank Wunder, 434 The Rookery, Chicago, has just sold a 200-light Western electric incandescent plant, complete, to the Bohemian Brewery Company, and a 50-light Western electric dynamo, complete, to the Rubber Paint Company, Chicago.

Mr. Charles Rusling, of Chicago, the western representative of the Thomson-Houston railway department, is escorting Mr. R. M. Clement and Mr. L. M. Clement, of Oakland, Cal., on a tour of inspection of the various electric railways in the large cities.

The Pond Engineering Company, of St. Louis, has received a telegraphic order for another 200-h. p. Armington & Sims compound engine from the Salt Lake Power, Light and Heating Company. This is the sixth Armington & Sims engine which this company has purchased within a little more than a year.

The Ball Engine Company, of Erie, Pa., has opened a branch office in Chicago in the Rookery Building, room 506. Mr. Albert Fisher, who has had a large experience in engine work, widely known as a successful salesman and an agreeable gentleman, has been appointed manager, and will be glad to see his friends in his new quarters. Mr. Fisher has had a large experience in engine work, and we predict for him success in his new connection.

The Electrical Supply Company, 102 and 104 Michigan avenue, Chicago, is sending out its fourth annual catalogue, No. 44, covering the supplies in the house goods department, including batteries, bells, annunciators, pushes, electric gas lighting apparatus, electric bell outfits, telegraph, fire alarm and district messenger apparatus, tools and supplies. Then follow illustrations of various forms of circuits that will be found of great convenience to the amateur as well as the practical electrician, and suggestions about the choosing of batteries for any character of work, directions for handling batteries, etc. As The Electrical Supply Company manufactures a majority of the articles enumerated purchasers can rely on receiving prompt shipments and should lose no time in sending for a copy of this very handsome catalogue.

The Davenport Gas Light Company, Davenport, Ia. will shortly have its new station completed and the machinery in operation. The Gas company deserves great credit for the energetic manner in which it has pushed the work forward and for its efforts to secure only machinery and apparatus of the highest standard. For the incandescent circuits the company has adopted the alternating system manufactured by the National Electric Manufacturing Company, of Eau Claire, Wis., while the arc lights are of the well known Western Electric type. The dynamos will be belted to pulleys on a line of shafting driven with the aid of clutch pulleys, all of which were built and and are being erected under the supervision of Mr. F. W. Weir, the general manager of the Chicago office of the Falls Rivet and Machine Company, of Cuyahoga Falls, O. The motive power is a Reynolds-Corliss engine built by the E. P. Allis Company, of Milwaukee, Wis.

F. DE L.

KANSAS CITY, Mo., Aug. 27, 1891.

Mr. William Bowen, of the Thomson-Houston company, is here on a business trip.

The Edison Company will put in a private plant at the State prison at Lansing, Kansas.

Mr. D. C. Hemingray, of the Hemingray Glass Company, Covington, Ky., is here this week.

Mr. L. C. Bair, a local electrician, has secured the contract for wiring the new County Court House.

Mr. C. A. Ross, of the Thomson-Houston company, has closed the contract for a 35-arc plant at Fort Smith, Ark. Also one of 150 arcs at Van Buren, Ark.

The National Electric Company, of Eau Claire, Wis., through its general agent, Thos. Woolfe, has put in a 1,000-light plant at Shenandoah, Ia.; also one of the same capacity at Stansbury, Mo.

The Soldiers' Home at Leavenworth, Kan., is to be equipped with a private electric light plant, both arc and incandescent. As the plant will be a good one, lively competition may be expected.

The Red Oak Electric Light Company, of Red Oak, Ia., was incorporated last week, with a capital stock of $20,000. A new building has been erected, and the company will be ready for operations about Sept. 15. Two Thomson-Houston dynamos will be used, and the capacity will be 30 arc and 750 incandescent. The following well known electricians of this city constitute the list of officers: Geo. E. Claflin, president; W. H. Blood, Jr., secretary and treasurer; A. M. Miller, superintendent and general manager. H. D. E.

SOUTHERN NOTES.

Newport News, Va.—It is stated that the Hampton and Old Point Electric Railway will be completed to the city within 80 days. A meeting was held at Hampton recently to consider the matter.

Henderson, N. C.—J. R. Young, A. C. Zollicoffer, J. D. Cooper and J. P. Taylor have purchased the electric light plant of the Henderson Electric and Gas Light Company, and will operate the same.

Washington, D. C.—The Hanson Battery, Light and Power Company, of 480 Louisiana avenue, is furnishing public places and residences off the electric wire line with electric fans, which are attracting considerable attention, being run by primary batteries. It is claimed by those who are using these fans that the prices are quite low. The fans are giving perfect satisfaction.

Americus, Ga.—The Americus Electric Street Railway was recently sold at receiver's sale. The road cost about $25,000, and was bonded for $50,000. T. J. Kenney, of Boston, Mass., who was bidding for the Thomson-Houston Company, the bondholders, bought the road for $35,000. The citizens of Americus will lose $10,000 by the sale, as that was the amount of stock subscriptions made by the people.

Atlanta, Ga.—The Georgia Electric Light Company has made a proposition to the City Council to furnish arc lights at $100 per year each, and incandescent at $40, the arc lights to be of 2,000 c. p. and the incandescent of 40 c. p. This is $20 cheaper for arc and $5 for incandescent per year than the city is now paying for its light. The contract is for three years, and the system to be used will be the Thomson-Houston.

Charleston, S. C.—The Economic Electric Light and Power Company opened its subscription books to the capital stock on July 13. The capital stock of the company is $100,000, shares $100 each. The plant is to be one of the most modern, and the company intends to put the price for light down so low that it will be within the reach of every one. As soon as the necessary stock is subscribed work will begin on the plant.

Salem, Va.—The Salem Street Railway Company, of which Colonel A. M. Bowman is president, has been granted a franchise for a belt line of electric cars by the City Council. Work is to begin within three months and be completed by the end of 13 months. One of the conditions upon which the franchise was granted is that the company shall pay quarterly to the Council two per cent. of all gross receipts for freight or passengers over the entire line.

Columbus, Ga.—Extensive improvements are being made on the electric light plant. A new 1,000-light dynamo is being placed in position, and a 250 h. p. compound condensing engine is being built at the Payne Engine Works, at Elmira, N. Y. When the new engine is ready for work the plant will have a capacity of 3,000 lights. When all the improvements are completed Columbus will have an electric light plant second to none in the State.

Asheville, N. C.—It is reported that a party of New York capitalists will build an electric railroad from Asheville to Rutherfordton, N. C., a distance of 40 miles. The road will run across the Blue Ridge Mountains and through the famous Hickory Nut Gap. If the road is constructed it will be one of the longest electric railroads in the world. Mr. Reynolds, the president, has applied for the right of way. Water power for running the dynamos will be furnished from the Chimney Rock Falls. V. N. B.

CANADIAN NOTES.

Montreal, Aug. 29, 1891.

The Electrical Exhibition.—The interest in electrical matters, and particularly those pertaining to the International Exhibition now so near at hand, continues to increase. People now are alive to the fact that it is going to be an exhibition unique in character, and are correspondingly curious as to what will be seen. Now that the public have got it into their heads that there is to be an exhibition, they ask what will be the benefits to be derived from it. In response to this, the *Shareholder*, one of the leading financial papers here, publishes an editorial in this week's issue devoted to the subject. It sets forth the advantages to be gained by the utilization of electricity as a motive power in the development of the valuable mines which now, from being too far from water power, are lying idle. It treats further of the practical use to be made of the vast water powers of the Dominion by means of the electric wire and shows that the exhibition cannot fail to be of great benefit to the country. I apprehend that scarcely any class of people is more interested in the practical application of the electric current than the mine owners. It has been my privilege during the last five years to see nearly every part of Canada from east to west and from the great lakes to the inhospitable regions of the Hudson Bay, and I was never so surprised as I am at the practically inexhaustible supply of mineral deposits. Ores of every description are found all over the country, and yet the work of mining and quarrying is in its very infancy. In some localities mines of unlimited value are but desert places, although within a few miles is a water power of sufficient volume to meet all demands. Now the capitalist who has half an eye for business will see his way clear to have these powers properly utilized. There can be no question about the benefits to be derived from the exhibition; the future before Canada, if Canadians will only look after their own interests, can but be a bright one, and certainly electricity will not make it any less so. As to the exhibition itself, it is bound to be a huge success. Already over 50 applications for space have been confirmed, and still they come. The floor is now covered with machinery, and the Thomson-Houston and Edison companies are working hard to get things into shape. Applications for rooms at the hotels are still pouring in, and everything goes to show that the influx of visitors will be very great. General Barney has his hands more than full, and is working hard to make everything go off with proper éclat. Certainly the Executive Committee knew what they were about when they appointed him manager. "Cirtcele."

ENGLISH NOTES.

London, Aug. 19, 1891.

The Manufacture of Phosphorus by Electricity.—A concern called the British Electrico-Chemical Agency Limited, having a capital of £75,000, has just been formed to carry out an agreement entered into with the Electric Construction Corporation. As Messrs Parker and Readman, of the Electric Construction Corporation, have recently brought out a very practical process for the manufacture of phosphorus by means of the electric furnace, it may be surmised from the title of this new concern that it is this process that it is proposed to work.

The Gas Industry.—Judging by the accounts just issued for the past half-year's working of the Gas Light and Coke Company (the biggest gas company, I believe, in the world), it is evident that the palmy days of huge dividends are temporarily, at any rate, eclipsed. A dividend at the rate of 13 per cent. per annum is indeed declared, but to meet this it has been necessary to draw upon the reserve fund to the extent of £160,000, in spite of the fact that this colossal gas undertaking received the splendid gross revenue for the half year of £1,928,000, an increase upon the previous half year of over £300,000. The present state of things does not appear to have arisen from anything connected with electricity or oil, but is solely due to the enormous increase in the cost of coal and labor. Apparently, the more work the company gets the more it costs them to do it.

Accumulator Cars at Birmingham.—The Birmingham Central Tramways Company has had some half a dozen accumulator cars in regular operation for the past 12 months, on a section of its system, and the recently published results of this company's operations afford an excellent opportunity for comparing the various methods of traction, since horse, electric, steam and cable cars are all employed. The accumulator cars, I am glad to say, appear to have acquitted themselves in a fairly favorable manner, the expenses per car mile coming out at 9.9 pence as against 10.99 pence for steam and 9.79 for horse cars, the cable system being credited with only 6.33 pence. When regarded from the point of view of net profit per car mile the electric cars came out a good second, their net earnings being 5¼d. against 6½d. for the cable cars and 4¾d. for the steam. On analyzing the working expenses, it is seen that the most formidable items are wages and car repairs, the latter amounting to nearly 2d. per car mile as against .83d. for cable cars, which are the next most expensive in this respect. When we consider that the accumulator cars are on a very small scale, only carrying 4 per cent. of the total number of passengers during the year, these figures are encouraging.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Scheme of Wiring.—(E. O. S.)—The scheme of wiring you send for criticism is faulty in that the distance to be covered is altogether too great for handling with the 110 volt dynamo. You had better not try to go so far, as the outlay for copper would be too great. Consult Hering's "Wire Computor" for rules for wiring.

Motor Winding.—I have a ⅛-h. p., 110 volt, series wound motor of the Perret two-pole type, with drum armature and 11 segments in the commutator. I want to run this motor on a 50-volt alternating circuit. Can you tell me how to do so? Subscriber.

There is no effective way of doing what you require. The frame might be rewound so as to answer after a fashion, but we would not advise you to try it.

Carrying Capacity of Wire.—(1) Will you please inform me if I can pass a current of about one ampère, 110 volts over No. 24 B. & S. gauge insulated wire without heating it too much? (2) What is the resistance of a 16 c. p. Edison lamp, and how much current does it require? Constant Reader.

(1) No. 24 wire will carry one ampère, but the loss of potential would be so great we would advise the use of No. 16 or 18 wire instead. (2) The current required by a 110 volt Edison lamp is about six-tenths of an ampère. You can figure the resistance hot from Ohms law and the electromotive force, and resistance cold will be nearly double that amount.

Overloading a Generator.—In "Answers to Correspondents" of Aug. 8, I notice a paragraph relative to raising the E. M. F. of a generator on a railway circuit in case of temporary overloading. While this procedure will no doubt raise the efficiency of transmission from overloaded feeders to accelerate the cars, I fail to see how it is going to ease the generator. Will you please explain? W. B.

It will not ease the generator, and was not intended so to do. If there is plenty of engine power, however, it will enable one to force the total output for the time being, and deliver a little more power at the cars. It is only an expedient at best, but one that will now and then prove quite effective.

Telephone Connections.—We have a power house situated 2½ miles from the office, and a private telephone connecting the two. This works admirably in the daytime; but at night, when the dynamos are running, owing to the noise of the machinery, the bells cannot be heard in the station. We have purchased an 8-inch vibrating gong. How can we operate that from the office by means of a push button?

Put a shunt around each telephone to the ground wire, with a switch in each shunt; the gong and a switch at one end, and the push button and a switch at the other end. Keep the switches closed except when you want to use the telephone. Call as usual with the push button; then throw open the switches, leaving the telephones in circuit. Possibly you have not battery enough.

Magnetization of Steel Bars.—I took a steel bar about 18 inches long, and, holding it in a plain magnetic dip, struck it a few blows with a hammer, with the usual result of one end attracting and the other end repelling the compass needle. I demagnetized it, and did the same thing over and over again until on one trial both ends attracted the same end of the compass needle and repelled the other. How could this be? J. S. S.

It is impossible to tell without investigating your bar and compass. It is possible to form subsidiary poles in a bar by mechanically changing the magnetic properties of the iron at some point in it; or it may be that you have weakened your compass needle by repeated trials of the bar, and hence both ends of your magnetized bar attract the same end of your compass needle, the first attracting it precisely as if it were a piece of soft iron, and the second likewise.

News of the Week.

THE TELEPHONE.

From Sparta to Ozark, Mo.—A telephone line is to be constructed between these two places. The line will be built by subscriptions of business men, and Mr. T. L. Dunlap, of Springfield, Mo., will superintend the construction.

From Pittsfield, Mass., to New Lebanon, N. Y.—The New England Telephone and Telegraph Company is rebuilding its 10 miles of line between these two places. Mr. I. C. Hoskins, of North Adams, has the contract. He will erect larger poles and cross-arms instead of brackets. The same company is rebuilding its line from Coatesville to Hinsdale on the same plan. This line is eight miles in length, and the cost of the improvements on the two lines will reach $2,500.

THE ELECTRIC LIGHT.

Newport News, Va.—The Lafayette House is placing a 1,500-light central station plant to be completed by Nov. 1, 1891.

Alton, Ill.—At a meeting of the directors of the Alton Gas and Electric Company, recently, it was decided to make improvements to the extent of $15,000 by adding to the present capacity of the plant. The capital stock of the company has been increased from $40,000 to $60,000.

Butte, Mont.—Mr. J. Gallagher, an employé of the Butte Electric Light Company, was seriously injured while engaged in repairing the electric light wires, by receiving a shock which was sufficient to knock him from the roof of the building upon which he was standing at the time.

York, Pa.—Dr. C. A. Isenhart recently purchased for the Peoples' Electric Light Company, from the Fort Wayne Electric Company, through Mr. G. A. Wilbur, the company's agent at Philadelphia, a Wood arc light dynamo of 60 lights capacity. It will be used for city illumination.

Wilmington, Del.—Proposals were received until eight o'clock Tuesday evening, Sept. 1, for lighting the streets of the city by gas and electricity for one, three and five years, commencing Friday, Jan. 1, 1892. There are now in operation in the city 33 arc and 382 incandescent lights.

Milwaukee, Wis.—When the hearing of the arguments in the injunction brought against the city by the Badger Illuminating Company, to restrain the city from advertising for bids to light the city by electricity, was called in the Superior Court, a postponement of two weeks was granted.

Ellenville, N. Y., is to be lighted by electricity and the plant is to be in operation early in September. The distance from the post office in Ellenville to the Rondout Creek, where the generating plant will be located, is 1¾ miles. It is estimated that the cost of the entire plant will be not far from $20,000.

Racing by Electric Light.—At Des Moines, Ia., where the State Fair grounds are to be lighted by electricity, it is said that a full programme of night races is being arranged and will soon be announced. The incandescent system will be used, the lights being of 32 c. p. The total number of lamps will be 558.

Circleville, O.—The City Council has accepted the proposal from the Pickaway Electric Power Company to light the city with electric lights. This company owns the gas plant from which the city is now lighted. There will be 110 arcs of 2,000 c. p. each, and the contract calls for 10 years' lighting at $75 per lamp per year.

Omaha, Neb.—The Thomson-Houston company has secured the contract to furnish the residence portion of the city with 700 incandescent lights. It is said, however, that the mayor will probably veto the agreement, owing to the fact that the city's appropriation for lighting purposes will not permit of this additional expense.

Kankakee, Ill.—Proposals are invited for furnishing 50 electric lights for lighting the streets of Kankakee for a period of three years; also for a sufficient number of incandescent lights for the proper lighting of the Council Chamber of the City Hall, and a few other lights. Proposals will be received by the City Clerk until September 12.

Leavenworth, Kan.—At a recent meeting of the City Council the Merchants' Electric Light Company, through its president, Charles M. Salinger, and its secretary, accepted the provisions of the ordinance granting to the company certain privileges. The new company is now ready for work, and will proceed with the business of furnishing electric lights.

Wheeling, W. Va.—Plans for the new electric light and power house have been presented to the City Council. The dynamo room will cover an area of 5,580 square feet. It has been decided to change the plans so as to make provision for six boilers instead of four and to advertise for bids for the additional apparatus. The entire length of the building will be 142 feet.

THE ELECTRIC RAILWAY.

The Central Traction Company, of Pittsburgh, operating the cable system, has under construction a feeder (to be run electrically) to its present system.

The Pittsburgh (Pa.) Traction Company, operating the cable system, is about to make extensive improvements in its power house, among which will be the putting in of a new 1,500 h. p. engine.

Lockport, N. Y.—Mr. O. F. Tiffany, representing the Olcott & Lockport Electric Street Railway Company, appeared before the City Council committee recently for the purpose of obtaining the right of way through certain streets of Lockport.

Lockport, N. Y.—The Lockport Electric Railway, Light and Power Company has made application for a franchise for a term of 50 years to use for street car purposes a number of streets in Lockport. The cars are to run either by electricity, cable or steam power.

The Brooklyn and Coney Island Railroad Company has closed a contract with the Short Electric Railroad Company for electric equipment to be put upon its line. This is one of the most prominent electric railways in the country, and its traffic is very heavy.

Vincennes, Ind.—A franchise for a new electric line of street cars has been asked for by the Vincennes Electric Company and the Thomson-Houston Electric Company. The line proposed for this new road is one that will not interfere with the travel on the principal streets.

Electric Cars at Chautauqua.—It is rumored that the Jamestown (N. Y.) Electric Railway Company, which has this year extended its lines to Lakewood, will before next summer continue the road to the south side of the lake from Lakewood to Chautauqua The distance to be covered is about 12 miles.

Kensington, Pa., a new town on the Allegheny River, about 14 miles from Pittsburgh, is showing that it is wide awake by em-

barking in a street railway project, which has taken definite shape. A charter has been granted to a company to engage in the street railway business in Kensington, and it is expected that work will begin on the construction of a line in a short time.

The Second Avenue Passenger Railway Company, of Pittsburgh, Pa., is putting in a large addition to its power house, the intention being to double the power of the plant. Thomson-Houston and Westinghouse motors are used by this company, with Thomson-Houston generators. The Greenfield avenue branch of the company, a couple of miles in length, now under construction, will be opened for travel about Nov. 1.

Lowell, Mass.—The street railway stockholders have voted to instruct the trustees to issue another $100,000 in capital stock, making $400,000 in all, and $1,000,000 in bonds. This will be done at a meeting to be held very soon. The power station will be 100 feet by 120, and of brick. This company has effected an insurance against accidents in the Travelers' Company, and future suits against the railroad for accidents will be defended by that company.

Beverly, Mass.—The directors of the Beverly and Danvers Storage Battery Road at their last meeting transacted little business of importance. It is said that a proposition was received from the Union Electric Car Company, of Boston, offering to sell the cars, engines, batteries, and the entire outfit. Also one from the Essex Electric Road, of Salem, offering to equip the road with horses and horse cars. The storage battery cars have not been in use for nearly a month.

The Short Electric Railway Company is making an active canvass in the West. Among its recent contracts for gearless motors may be noted that at Harvey, Ill., one of the suburbs of Chicago. The Harvey Transit Company, composed of some of the heaviest capitalists in Chicago, is building this railway, and has made a most careful and thorough investigation of the different electric railway systems, finally deciding on the Short gearless motor as being successful in every respect.

Gearless Motor Installations.—The Short Electric Railway Company has closed a large number of contracts for "Gearless" motors for fall delivery. It will commence from the first factory order now nearly completed at its works early in September, and the motors will shortly be running at St. Louis, Mo.; Albany, N. Y.; Louisville, Ky.; Indianapolis, Ind.; Washington, D. C.; Lincoln, Neb.; Rochester, N. Y.; Houston, Tex.; Harvey, Ill.; Cleveland, O.; Pittsburgh, Pa.; Wilkesbarre, Pa.; Brooklyn, N. Y.; Hot Springs, St. Dak., etc.

Tests on the Short "Gearless" Motor.—During the past month the "Gearless" motor has been very thoroughly tested in Cleveland, being put to the hardest hind of work in regular commercial operation. Among some of the noteworthy tests may be mentioned the following: In order to prove the power of the motor, it was attached to two other motor cars and drew them without difficulty along a rough and dirty track, attaining a very fair rate of speed. The car was stopped at the commencement of a 40-foot curve, at the other end of which was a 3 per cent. grade. It was then started up, and without difficulty drew the three cars around the curve and up the grade. This was one of the severest tests which could be put upon the motor under all the conditions. The car was put into regular service on three of the Cleveland street railway lines, carrying trail cars and drawing heavy loads without the slightest difficulty and at speeds far in advance of the ordinary schedule of the road. Current and voltmeter readings were taken in each case, showing that the power consumed was even less than had been anticipated by the Short people themselves.

GENERAL APPLICATIONS OF POWER.

Bridge to be Operated by an Electric Motor.—The draw of the Harvard Bridge over the Charles River will be operated by an electric motor, which will be placed in position in about six weeks. There will also be 64 electric lights on the bridge.

LEGAL NOTES.

Nashville, Tenn.—The Capital Electric Company has been sued for $50,000 by the Thomson-Houston Company, for default of interest.

Ball Engine Suit.—We are informed that the suit over the Ball engine has been decided in favor of The Ball & Wood Company, of New York, by the United States Circuit Court.

Lebanon, Pa.—Judge Simonton has dissolved the injunction in the case of Henry S. Heilman against the Lebanon & Annville Electric Railway Company. The petitioner endeavored to prevent the railway company from occupying the turnpike in front of his residence. The work of building the road will now go on.

Rutland, Vt.—The taking of testimony in the case of the Rutland Electric Light Company against the Marble City Electric Light Company before Mr. S. C. Shurtliff, of Montpelier, was begun last week. This is an action in which the Rutland Electric Light Company claims that the wires of the Marble City Electric Light Company trespass upon its rights. The report will probably be made at the September term of the County Court.

The New York and New Jersey Telephone Company has begun a suit in the Supreme Court in Brooklyn, for an injunction to restrain the Equity Gas Light Company from interfering with its conduits, and for $150 on account of the damage already done in the Eastern District. The affidavits presented with the proceeding allege that the defendant is preparing to tear out the plaintiff's conduits and manholes, and to blast rocks which will endanger them, and an injunction is asked for to prevent damage to the plaintiff's property.

PERSONAL NOTES.

Mr. F. J. Sprague has a very readable article in the September *Forum* on "The Future of the Electric Railway."

Mr. Morris W. Mead, superintendent of the Bureau of Electricity of Pittsburgh, is making a trip through the West, and will visit Chicago and St. Louis. He expects to be gone about ten days.

Mr. C. G. Merriwether, superintendent of the southern division of the Western Union Telegraph Company at Mobile, died last week. Mr. Merriwether held this place for many years, and was well known throughout the telegraph fraternity.

Mr. F. H. Gardner, who for the past two years has been manager of the Lynn (Mass.) Telephone Exchange, has accepted a more prominent position in the general manager's office of the Boston exchange. Mr. Gardner was reminded of the esteem in which he was held by the employés of the Lynn exchange by their presentation to him of a gold ring.

Mr. W. E. Harrington has resigned his position as superintendent of the Pennsylvania Railroad Company's Electric Railway at Atlantic City, N. J., after having been in charge of the station since its erection in 1889. Mr. Harrington has made an engagement with Thomas H. Dallett & Co., of Philadelphia, as manager of their railway department, and will assume his duties in his new position on the 15th of September.

Mr. S. A. Barton, formerly a director of the Thomson-Houston Electric Company, who resigned on account of illness, and who is now president of the Brush Electric Company, has been re-elected a director of the Thomson-Houston Company. Since Mr. Barton recovered he has organized the purchasing department of the Thomson-Houston Electric Company, which makes all the purchases for the Thomson-Houston Company and its allied interests, aggregating between $6,000,000 and $8,000,000 annually. Mr. Barton will take up the organization of another important department of the business, in the direction of which he will be actively interested.

EDUCATIONAL NOTES.

Pratt Institute.—The course in electrical construction at this institute in Brooklyn during the coming year aims to give a knowledge of the principles of dynamic electricity and magnetism, and to trace the application of these principles to the methods and construction of actual practice. Instruction is given by means of lectures and laboratory work. The lectures take up the analysis of the magnetic field and lines of force, magnetic circuit, properties of electric current, electromagnets, induced electromotive force, electrical units and work of currents, and the application of these principles to the construction of primary and secondary batteries, telephones and telegraphs, dynamos, motors, transformers, measuring instruments, and arc and incandescent lighting systems. The laboratory work deals with the verification of the laws brought out in the lecture-room, and affords continuous practice in the use of measuring instruments—voltmeter, ammeter and Wheatstone bridge, and experimental study of the action of both continuous and alternating current dynamos and motors.

MISCELLANEOUS NOTES.

A Montreal Souvenir has been issued by the secretary of the National Electric Light Association. It contains a full list of the various committees and the officers of the association, information in regard to transportation arrangements and hotel charges, the convention programme and a general description of Montreal and its surroundings.

To Exhibitors at the Montreal Convention.—Mr. James I. Gulick, chairman of the committee on exhibits, has issued a notice informing intending exhibitors that freight and express charges should be prepaid in order to prevent delay at Montreal. Duplicate invoices, certified as correct as to quantity and selling price, should be made out and signed by the firm or by an officer of the corporation. These invoices and bills of lading should be mailed to Gen. C. H. Barney, at the Victoria Skating Rink, Montreal.

A New Electrical Block System for Railways.—Dr. A. H. R. Guiley has patented a new block system for railways which is operated by electricity. Its object is to tend to prevent railway collisions by giving an alarm to an engineer on a moving locomotive when approaching a standing or a moving locomotive on the same track, and which will give notice of an occupied grade crossing, an open switch or drawbridge, or a car projecting from a side track over the main line, and which will afford a signal effective in daylight or darkness, on a straight or curved track, or in a tunnel. The business management of this invention is in the hands of Mr. E. B. Cornell, 922 North Nineteenth street, Philadelphia, Pa.

Industrial and Trade Notes.

Wiring the Masonic Temple.—This one of Chicago's new "sky-scrapers" alone requires over 65 miles of concealed circuits, and all of this will be Simplex braided caoutchouc wire. After some close bidding the contract for supplying it was awarded to the Simplex Electrical Company's western agent, George Cutter.

The Keystone Electric Company, of Erie, Pa., shipped last week a 2 h. p. motor to Scranton, Pa., and has installed a 2 h. p. in a wire fence factory, a 3 h. p. on a Sturtevant blower for the Edison Electric Light and Power Company, a 2 h. p. in a pattern maker's shop, and a 5 h. p. for the Erie Piano Company, all of Erie, Pa.

The Manhattan Electrical Supply Co., 36 Cortlandt street, New York City, has issued a little circular describing the Mesco dry battery as manufactured for call bells, annunciators, burglar alarms, telephones, medical apparatus, and all open circuit work. The company disclaims any liability of infringement on their dry batteries.

The New York and Ohio Company, manufacturers of the Packard incandescent lamp, has just completed arrangements with The Electric Engineering and Supply Company, of Syracuse, N. Y., to look after its interests in Pennsylvania, New York, New England States and the Dominion of Canada, and this company will also represent the Packard lamp at the Montreal convention.

Mr. I. P. Frink, of 551 Pearl street, New York city, manufacturer of the well known "Frink" reflectors, has recently made installations in the following churches: Baptist Church, E. Weymouth, Mass.; M. E. Church, Sedalia, Mo.; M. E. Church, Orono, Me.; Central M. E. Church, Raleigh, N. C.; M. E. Church, Babylon, N. Y.; St. Andrew's M. E. Church, Wilmington, N. C.; Church of Christ, Auburn, N. Y.; Free Mason St. Baptist Church, Norfolk, Va.

The Card Electric Motor and Dynamo Company, of Cincinnati, O., has issued a light and power pamphlet, which is nicely printed and bound in illuminated covers. It contains considerable information regarding the electric motors and dynamos manufactured by this company, and some fine illustrations of these machines. An illustration and description of the ball bearing used in the Card motors and dynamos were given in THE ELECTRICAL WORLD of Aug. 29.

The Vulcanized Fibre Company, of Wilmington, Del., has sent out a special notice, which says that in view of the great success of this company and the high reputation of vulcanized fibre all over the world, a number of smaller concerns have started to imitate the company's goods, selling them under various names. These goods are said to closely resemble those put on the market by the Vulcanized Fibre Company, and that company cautions buyers that all goods put out by it are branded "Vulcanized Fibre."

Manufacture of Insulator Pins.—A new factory for the manufacture of insulator pins and brackets has been located at Morgantown, W. Va., by J. F. Tener, of 54 Bluff street, Pittsburgh, Pa. The lathes for turning the pieces are of a new design, and Mr. Tener claims that his goods are superior to those made on any other machine now used. The chief point of excellence is in the thread, which is exceptionally good. A number of orders have already been received for the product of the new factory.

The Page Belting Company has sold the Reading and Southwest Electric Railway, of Reading, Pa., its whole outfit of belting, consisting of Acme link and Eureka dynamo belts. This company has also sold four Eureka dynamo slotted belts to the Schuylkill Electric Railway Company, to the Sea Shore Electric Railway, at Asbury Park, N. J., a full equipment of belting, and to the Reading (Pa.) Electric Light Company a main driving belt, 58 inches wide, and 800 feet of Eureka dynamo slotted belting.

The Reliance Safety Water Columns, manufactured by the Reliance Gauge Company, Cleveland, O., are rapidly coming into general use. The East Cleveland Railroad Company recently placed a second order for seven, and they were recently adopted by the city electric light plant at Wheeling, W. Va. It is claimed for these appliances that they cause the water to be carried uniformly at the proper level, thus insuring steady power and obviating stoppage for repairs while effecting a considerable saving in fuel.

The Ottumwa (Ia.) Railway Electric and Steam Company has contracted with the American District Steam Company, of Lockport, N. Y., for an extension of about three-fourths of a mile of underground exhaust steam mains. Two years ago this company put down about two miles of steam mains for the purpose of utilizing exhaust steam from its electrical work. The company has been heating a large number of houses and other buildings with exhaust steam at but little additional cost for fuel or labor, with most satisfactory results, hence this extension.

Sales of Ball Engines.—The Hotel Savoy, Fifty-ninth street and Fifth avenue, New York City, has purchased for its electric light plant three 100-h. p. and one 60-h. p. engines through E. T. Copeland & Co 106 Liberty street, New York. The engines are manufactured by the Ball Engine Company, Erie, Pa. The Johnson company, Johnstown, Pa., has just installed a 300-h. p. cross compound engine of the same company's manufacture for its electric welding plant. The Tuscarawas Electric Company, Canal Dover, O., has also ordered a 100-h. p. engine from the Ball Engine Company.

The girder rail models recently made by Wm. Gardam & Son, of 98 John street, New York City, for the Johnson company, which is furnishing the rails for the Broadway cable road, have been much admired, and are attracting considerable attention. This firm, so celebrated for its model and experimental work, justly deserves all the praise given its handsome productions. The Peckham models, so well known to all street railway men, emanated from the Gardams' factory. They say that should they get a fair percentage of the work they are at present making bids for, they will be happy for many a day. The approaching conventions with their requirements in the way of models, etc., are making business better.

The Falls Rivet and Machine Company, of Cuyahoga Falls, is now busy in erecting or constructing line shafting, pulleys, clutch couplings, etc., for the following electric light plants: Masonic Temple, Chicago, Ill.; Beaver Falls Traction Company, Beaver Falls, Pa.; Reading Electric Light and Power Company, Reading, Pa.; Davenport Gas Light Company, Davenport, Ia.; Cincinnati Street Railway Company, Pendleton Street Station, Cincinnati, O.; Louisvillle Electric Light and Power Company, Louisville, Ky.; Louisiana Electric Light Company, New Orleans, La.; Pulaski Electric Light Company, Pulaski, Tenn.; Wheeling Electric Light Company, Wheeling, W. Va.; Brush Electric Company, Cleveland, O.; Pittsburgh Plate Glass Company, Ford City, Pa.; Cedar Rapids Electric Light and Power Company, Cedar Rapids, Ia.; Belt Line Electric Company, Lexington, Ky.; Covington Electric Light Company, Covington, Ky.; Indiana Electric Light Company, Indiana, Pa.; Municipal Electric Lighting Company, St. Louis (addition).

The James Leffel & Co., of Springfield, O., have issued a new pamphlet describing the well known Leffel water wheel. The pamphlet is well printed on finely finished paper, is handsomely illustrated throughout, and contains a large amount of useful and practical matter of value to those who contemplate improving their water power. A great number of plans for placing wheels are shown, both upon upright and horizontal shafts. New tables of the wheels are published, containing valuable information not heretofore published. This firm has been making the Leffel water wheel for 30 years continuously, and its business is conducted by the same parties and managers that have been with the concern since its early history. One hundred and ten different sizes and styles of wheel are made, and the company has shops, tools and patterns designed exclusively for this business and turns out more and better work to-day than at any time heretofore. The concern will be glad to mail the new pamphlet to any of those interested who will make application for it. The New York office of the company is at 110 Liberty street.

Water Tube Boiler Industry.—John Wood, Jr., of the Schuylkill Foundry and Machine Works, Conshohocken, Pa., has shipped the following Wood's water tube boilers recently, together with a large number of smaller orders: 300 h. p. to the Cheltenham Electric Light Company, Philadelphia; 300 h. p. to the Johnstown Electric Railway Company; 300 h. p. to the Reading and Southwestern Electric Street Railway Company; 300 h. p. to the Lebanon and Anneville Electric Street Railway Company; 2,000 h. p. to the Duncannon Iron and Steel Company, Duncannon, Pa.; 1,900 h. p. to the J. Wood & Bros.' Iron and Steel Company, Duncannon, Pa.; 3,000 h. p. to the Windsor Locks Steel Company, Connecticut; 250 h. p. to the Seyfert & Bro.'s Steel Company, Reading; 200 h. p. to the Valley Rolling Mills, Centreville; 300 h. p. to the Hughes & Palboon Rolling Mills, Philadelphia; 2,000 h. p. to the John & James Dobson's Carpet Mills, Philadelphia; 200 h. p. to the Flanigan & Bro.'s Woolen Mill, Philadelphia; 400 h. p. to the Alex. Kerr Bro. & Co., New York and Philadelphia; 200 h. p. to the Pottstown Iron and Steel Company, Pennsylvania; 250 h. p. to the Pottsville Iron and Steel Company, Pottsville, Pa.; 100 h. p. to the Rogerford Stove Works; 100 h. p. to the Townsends' Carpet Mills, Morristown, Pa. Mr. Wood reports orders coming in fast from all parts. Orders for over 5,000 h. p. are now on hand and in course of construction for electric street railways and electric lighting.

To Manufacture the Fibrous Batteries.—We have received information that the fibrous dry battery and the fibrous disque Leclanché porous cup are hereafter to be manufactured exclusively by Messrs. Thompson & Robertson, 258 Broadway, New York City. This battery and cup, it will be remembered, have been manufactured for some time by Messrs. Taylor & Walsh, of this city. The firm of Thompson & Robertson is well fitted for this work, and will take the matter up and carry it forward in a systematic and business-like way. The first named member of this firm is the Hon. Roscoe H. Thompson, formerly of Boston and the late treasurer of the Fibrone Manufacturing Company of this city. Mr. J. Hart Robertson, under whose supervision the batteries will be manufactured, is a member of the New York Electric Club, and a well known electrician, the most prominent of his inventions probably being the writing telegraph, of whose working an exhibition was recently given between New York and Chicago, and which attracted considerable attention. Mr. Robertson, however, considers the fibrous battery the most promising of his inventions and will give all his time to its manufacture at the company's factory in Bloomfield, N. J. Mr. Louis Walsh will be the efficient manager of the sales department of the company's business. Mr. Walsh has had an extended experience in several branches of the electrical business. Although he spent five years with the Daft Electric Company he is probably best known to the electrical trade though his connection with the Crosby Electric Company, of this city, whose goods were introduced by Mr. Walsh and rapidly came into very general use. He has been connected with the firm of Taylor & Walsh for a short time and now leaves that concern to assume the duties of his new position. The fibrous dry battery is adapted for all open circuit work, is small, being only

4¼ × 3 inches, and cylindrical in shape, and is the only dry battery in the market that is not sealed. Under the management of these gentlemen these goods will soon take a front rank with similar apparatus now in the market.

The Acme Lead Cable.—One of the latest products of the International Okonite Company (Limited), of New York and London, is a lead covered cable designed for extra heavy work and high voltage under extremes of temperature, being especially adapted for underground work. A special feature of the new cable is its thorough insulation, which consists of a combination of two or more distinct insulating materials, possessing different valuable qualities—one of the high electrical resistance of okonite, the other an improved rubber compound specially adapted to resist the effects of high temperature. The high insulating properties of okonite are well known to the trade. The special rubber compound, which also possesses high insulating and water-proofing qualities, has the additional advantage of not being sensitive to heat. Its application serves as a protection to the high grade okonite insulating material beneath, and insures centralization of the conductor at high temperature. In other words, it does not soften; neither does it allow the conductor by its weight to sag down through the insulating materials. After this second layer is applied, the cable thus far made is run through a bath under high heat until the insulation becomes impregnated with a material which protects it thoroughly from the effects of gas and moisture. Over these two layers of special insulating material is superimposed a braid which in its turn is saturated with the same material to prevent capillary attraction to the exposed ends of the cable and protect it from the rottening effects of gas, and to increase its lasting qualities, making it a very durable braid. Though more expensive the manufacturers use a braid in preference to a tape, on account of its superiority. Being elastic it does not break on bending as the tape is sure to do, but gives readily. The cable is then lead-covered by improved hydraulic processes, insuring freedom from blow holes and air bubbles, and an even thickness and quality of lead. The lead is alloyed with tin, to secure sufficient hardness and to resist abrasion in drawing through ducts, yet assuring sufficient ductility to enable the cable to be easily handled without rupture.

H. Ward Leonard & Co.—In the prospectus of this new concern there occurs the following statement of the intention of the company: "This company has been organized with the special object of undertaking work involving the necessity of a wide comprehensive experience in the electrical field and such a knowledge of electrical, mechanical, chemical and mining work as is necessary for the intelligent application of electricity to new uses and such as does not at present exist outside of the large electrical companies. It is well known that the best experts of the large companies are kept so busy on profitable routine work that they are not so readily available to develop a new application of electricity as would be similar experts whose work would lie entirely in that direction. In other words, the best electrical engineers are largely occupied with the planning and constructing of electric railway plants, arc-lights plants and incandescent plants, and find little, if any, time in which to give attention to the development of new applications of electricity. A prospective purchaser to-day, who wishes power transmitted great distances and then utilized as far as possible in a good-sized town, finds himself confronted by conflicting statements as to what is possible and necessary, and also finds that the parent companies, whose shops are full of profitable standard work, do not exert themselves to secure a contract involving the services of their best engineers at great distances from home, and upon plants no two of which are likely to be sufficiently alike to allow of more duplication as in railway lighting plants. Furthermore, the parent companies are primarily manufacturing companies, and do not do construction work except for the purpose of insuring the sale and proper installation of their manufactured goods, and they have of course no interest whatever in selling or installing the goods of a rival manufacturing company. Suppose a prospective purchaser wants to develop a water power and transmit it 10 miles to a town where he wishes to use it for incandescent lighting, arc-lighting, operating stationary motors, a railway, charging storage batteries, and the operation of welding machines. He may wish Edison incandescent lamps on a Westinghouse alternating system for scattered lighting, an Edison street railroad, Eddy stationary motors, a Thomson-Houston arc-lighting plant, Julien storage batteries and Thomson welding machines. He wishes the entire responsibility in some competent hands. Which one of the above companies would care, for the sake of selling such a small amount of its own apparatus, to develop the water-power, construct the entire plant and purchase from other competing companies and become responsible for apparatus which they themselves may have no faith in. It is evident that each company will endeavor to sell f. o. b. as much of its own apparatus as it can. The purchaser cannot determine whether to transmit by alternating or continuous currents, whether to use storage batteries or not, nor any one of the perplexing points which change with almost every plant, and which only those most experienced are competent to judge. It is for just such work that we are organized, without any prejudice for or against any apparatus or system, except that based upon our honest judgment after a thorough experience extending over the entire development of electrical engineering since 1883, and having nothing whatever to sell, and having no alliances with any manufacturing concern, we are able to say to the prospective purchaser: 'We are organized to serve your interests in the best way possible, and to give close and expert attention to every point in connection with your plant, from the original selection and purchase of your property to the details of the methods of operation after we have installed it for you.'"

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED AUG. 25, 1891.

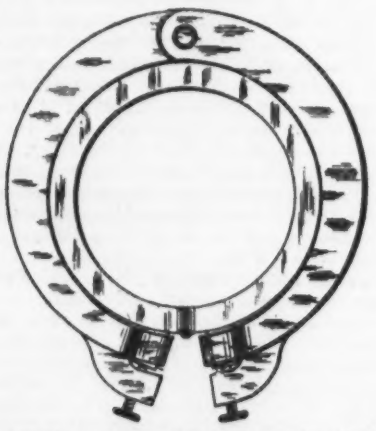
458,154. Automatic Gas-Lighting Apparatus; George D. Clarke, of Chicago, Ill., Assignor of five-eighths to Wilson S. Chapman, of the same place. Application filed Dec. 30, 1890. An electromagnet coil, in combination with its core, consisting of a soft iron tube and soft iron rods placed in an annular space around the tube within the spool, the armature of said electromagnet and sparking contacts, against which the gas admitted through the core is adapted to be thrown, whereby the sparks are produced, while at the same time the magnet armature is held by the attractive force of the electromagnet.

458,162. Electric Motor; Ludwig Gutmann, of Fort Wayne, Ind. Application filed Dec. 1, 1888. An alternating current motor consisting of field magnet coils connected to the terminals of an alternating current generator, an armature provided with coils, and brushes independent and insulated from each other, permanently short circuiting less than all the armature coils.

458,163. Alternating Electric Current Heater; Ludwig Gutmann, of Pittsburgh, Pa. Application filed Dec. 9, 1889. An electric heater having an alternating, pulsating or intermittent current generator and circuit connections, an electromagnet in circuit with said generator, a magnetic or electric substance serving as a platform for supporting cooking utensils, located within inductive relation to said electromagnet, and means, such as perforations, in said magnetic or electric substance, for the passage of the heated air.

458,164. Method of Operating Alternating Motors; Ludwig Gutmann, of Pittsburgh, Pa. Application filed Feb. 4, 1890. An electric motor having exciting coils, field magnets therefor, secondary exciting coils in inductive distance from the first named coils, armature coils provided with conductors close-circuiting themselves in groups, and means for changing the circuit connections of said secondary exciting coils. (See illustration).

458,176. Art of Electric Welding; Hermann Lemp, of Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed May 31, 1890. The method of improving electric contact, which consists in inserting films of liquid, such



No. 458,177.—Adjustable Electric Clamp.

as water, between the clamping surfaces and the surfaces or portions of the same clamped when such surfaces are not in actual metallic or firm contact.

458,177. Adjustable Electric Clamp; Herman Lemp, of Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed Oct. 9, 1890. Electric clamps having holding devices for gripping the work pieces, and adjustable contact pieces of good conducting material for conveying current to the work pieces. (See illustration).

458,188. Electric Clamp; Einar Rasmussen, of Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed Dec. 19, 1890. The invention consists of the combination of a yielding piece of good conducting material with the conducting devices of electric welding and metal working apparatus.

458,221. Insulator; Murray C. Chase, of Chicago, Ill., Assignor to the Electrical Supply Company, of Illinois. Application filed Nov. 14, 1890. An insulator consisting of two projecting metallic ends with enlargements, and a cylindrical coupling piece with inward projecting ends within which lie the enlargements and interposed insulation.

458,236. Armature for Dynamo-Electric Machines; Laurence A. McCarthy, of Brooklyn, N. Y. Application filed Feb. 18, 1891. In an armature for dynamo-electric machines, the combination of a magnetic core having narrow projecting teeth with coils of wire connected together in pairs, one coil of each pair wound around the tooth of the opposite side of the core from the other coil of the pair.

458,242. Electric Lamp Socket; Horace E. Swift, of Boston, Mass. Application filed March 23, 1891. A switch for incandescent lamps, comprising the instrumentalities, viz.: a block having posts, a plate having a portion connected with one terminal of the lamp, a plate connected with the other terminal of the lamp, and with which a spring acting piece is adapted to make and break connection, a rectangular block, a shaft on which it is mounted, and a pin and thumb-piece.

458,249. Electric Power Brake; Clarence V. Greenamyer, of San Francisco, Cal., Assignor to the Verner Wrench Car Mover and Power Manufacturing Company, of California. Application filed December 2, 1890. A power brake for revolving shafts or axles, having a hinged jaw adapted to embrace the shaft, arms or levers which are extensions of the parts of said jaw opposite the hinge, eccentrically pivoted wheels or rollers in the jaw, and means applied to the arms or levers to draw them together and close the jaw against the shaft.

458,258. Spring-Jack Commutator for Telephone Switchboards; Louis Alfred Berthon, of Paris, France, Assignor to the Societe Generale des Telephones (Reseaux Telephoniques et Constructions Electriques.) Application filed Jan. 30, 1891. The combination of an insulating plate, tubular contact-sockets fastened thereto along one edge, and transversely arranged jack springs fastened along the opposite edge of the plate, with a longitudinal part engaging notches in said springs for holding them in place.

No. 458,343.—Circuit Closer.

458,278. Electric Stop Mechanism; Ernest Boening, of Yonkers, N. Y. Assignor of one-half to August Sundh, of same place. Application filed July 24, 1890. In a stop mechanism, the combination with a motive part, of a tappet mounted on, and moving with said motive part, a pin or rod movable into the path of said tappet, an electromagnet for moving the pin or rod, and means connected therewith whereby the transmission of power is stopped when the magnet is energized.

458,279. Portable Electric Lamp; Lars Bristol, of Bromley, England. Application filed Aug. 28, 1890. The combination, with the lid of a portable electric safety lamp, of a lug or lugs, covering one or both terminals of a secondary battery, and a bossed lug, containing a safety lock.

458,316. Electric Conductor; Frederick E. Degenhardt, of Chicago, Ill., Assignor to the Standard Underground Cable Company, of Pittsburgh, Pa. Application filed Sept. 1, 1890. The combination of a conducting wire and a strip or strips provided with air filled perforations surrounding the same. (See illustration).

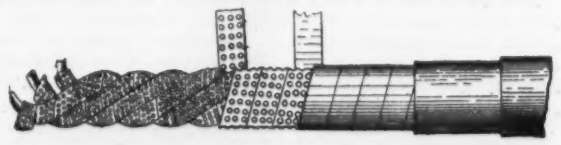
458,343. Circuit Closer; Percival D. Richards, of West Medford, Assignor of one-half to Charles H. Delano, of Woburn, Mass. A circuit closer fitted to be grasped by the hand, having a body formed wholly or in part of a conducting material adapted to be placed in connection with one conducting wire, and an exterior series of flexible strips or wires adapted to be placed in connection with the other conducting wire, whereby when the circuit closer is grasped by the hand and compressed the strips or wires are forced into contact with the body and the circuit is closed. (See illustration.)

458,376. Arc-Lamp Electrode; Walter S. Richards, of Natick, Assignor of one-half to George B. James, of Boston, Mass. Application filed Jan. 8, 1891. An electrode having a capillary conductor of refractory material extending along its exterior, said conductor being exposed to the atmosphere.

458,377. System of Electrical Propulsion for Vehicles; Walter S. Richards, of Natick, Assignor of one-half to George B. James, of Boston, Mass. Application filed Jan. 19, 1891. The combination of a way or road, primary electric coils disposed in series along said way and connected with a dynamo or other source of electricity, a vehicle adapted to travel on said way, propelling mechanism on said vehicle, and electric motor on said vehicle for operating the propelling mechanism, and secondary coils on said vehicle connected with said motor and adapted to be inductively electrified by said primary coils.

458,386. Electric Arc Lamps; Nathan M. Garland, of New York, N. Y., Assignor of one-half to Clift Wise, of same place. Application filed Dec. 29, 1890. An arc light having its upper carbon provided with a movable protecting cap or hood of refractory material of substantially the same internal diameter as the carbon, but shaped to bear against the coned end thereof and adapted to move in the direction of the support of the carbon as it burns away.

458,387. Electric Arc Lamp; Nathan M. Garland, of New York, N. Y., Assignor of one-half to Clift Wise, of same place. Application filed Dec. 29, 1890. An arc light carbon provided with a



No. 458,316.—Electric Conductor.

protecting cap or hood sustained in position by a spiral spring connected to a point in alignment with the carbon.

458,388. Electric Arc Lamp; Nathan M. Garland, of New York, N. Y., Assignor of one-half to Clift Wise, of same place. Application filed Dec. 29, 1890. An arc light having a protecting cap or hood for each carbon, said hoods being mechanically connected together by a resilient or yielding support, and provided each with one or more conductors of heat for dissipating or conducting away as far as possible the surplus heat evolved at the arc.

458,389. Electric Arc Lamp; Nathan M. Garland, of Boston, Mass., Assignor of one-half to Clift Wise, of New York, N. Y. Application filed May 18, 1891. The apparatus for increasing the efficiency and life of an arc light carbon, consisting of a protecting tube having substantially the same diameter as that of the carbon, in combination with one or more perforations or air-vents and groove forming retaining devices extending into the path of the carbon near the lower end of the tube,

458,396. Cut-Out; William F. Irish, of New York, N. Y., Assignor of one-half to Charles G. Perkins, of Hartford, Conn. Application filed Sept. 15, 1890. In a cut-out, a base bearing yoke shaped conducting plate, the terminals of which are connected by safety plugs, a spring actuated lever oscillating in the plane of breaks in one of the conducting plates, and a catch held by one of the plugs with its end in contact with the lever.

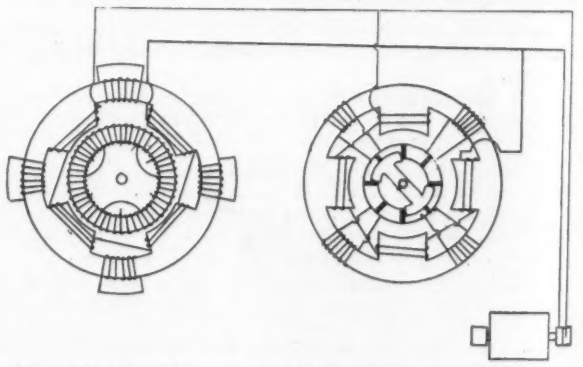
458,424. Secondary Battery; Orazio Lugo, of New York, N. Y. Application filed May 26, 1891. In combination with metallic or other substance for a secondary or storage battery a solution of borate of ammonia.

458,425. Secondary Battery; Orazio Lugo, of New York, N. Y. Application filed May 26, 1891. A relatively electro positive metal or substance, and a relatively electro negative metal or substance, both coated with a suitable oxide, such as oxide of lead, and placed in a liquid, such as a solution of borate of ammonia, which will not act primarily upon either, but will act secondarily upon both.

458,427. Support for Trolley Wires; John H. Palmer, of Boston, Mass., Assignor of one-half to Richard Smith, of Sherbrooke, Canada. Application filed Dec. 19, 1890. A wire support consisting of a hanger plate, having a recess and a yoke, having a body or supporting part, straight on its lower side, and a key passing through apertures in said yoke and plate to hold the parts together.

458,479. Telephone; Eloy Noriega, of Mexico. Application filed Feb. 4, 1891. A receiving-telephone comprising a hollow handle having an enlargement at one end and provided with an earpiece having a diaphragm and closing the enlarged end of the handle and at its opposite end with binding-posts, a permanent compound U-shaped magnet secured in the handle at its bend and provided with pole pieces secured between the ends of each member of the compound magnet and extending in close proximity to the diaphragm, and bobbins on the pole-pieces connected with each other by one terminal having the other terminals connected to the binding posts.

58,486. Electric Gas-Lighter; Horace A. Pinkham, of Philadelphia, Pa., Assignor to George F. Pinkham, of Wollaston, Mass. Application filed Oct. 25, 1890. In an electric gas lighting burner, the combination, with the plug of the stopcock arranged



No. 458,164.—Method of Operating Alternating Electric Motors.

vertically within the shell and provided with a thumb piece or handle and the pillar or vertical portion forming a prolongation or upward extension of the said plug, of a fixed electrode and a movable electrode consisting of a sliding pin or rod having a suitable terminal, a sleeve encircling and forming a guide for said sliding pin or rod, said guide being attached to and adapted to be rotated with the vertical portion, a cam or incline for raising said rod as its lower end is caused to travel in contact therewith by the rotation of the said vertical portion to carry its terminal above the level of the terminal of the fixed electrode, and a spring for retracting the rod after it has passed off the end of the cam.

458,489. Electric Signal and Switch Moving Mechanism; Joseph Ramsey, Jr., Edward W. Harden, and Charles Morris Wilder, of Cincinnati, O., Assignors to said Ramsey, Jr., and Frederic C. Weir, of same place. Application filed Feb. 5, 1891. In combination with a motor having gyratory transmitting-links, devices for converting rotary into reciprocating movement, a crank, and a pitman connected directly to the switch-rails.

458,499. Electric-Arc Lamp; Hermann W. Sander, of St. Louis, Mo., Assignor of one-half to Martin D. Memmel, of same place. Application filed May 4, 1891. An arc light having circular carbons pivoted to swing together, of a guide-arm having branches provided with insulating or non-conducting sleeves through which the said carbons pass.

458,536. Electric Uterine Supporter; George F. Mohn, of Los Angeles, Cal. Application filed March 20, 1891. The combination of a belt, a battery, a uterine supporter provided with a metallic lining connected with one pole of the battery, and a rear electrode connected with the other pole of the battery and arranged to be applied to the back of the patient.

458,545. Electric Motor; Charles E. Egan, of Columbus, Assignor of three-fourths to William H. Weitzell, of Logan, and J. F. Casey, of Zanesville, O. Application filed Nov. 25, 1890. In an electric motor car, the combination with the body and a battery-tank supported therein, of feed pipes leading into said tank through the car frame, and outlet tubes, of rubber, leading from said tank, and means for closing and opening said tubes.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.